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Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by Francis Anthony Chevalier de Gerstner, *during his sojourn in the United States, in* 1839.

(Translated from the German, by L. Klein, Civil Engineer.)

The late Chevalier de Gerstner, so well known to the public by the construction of the first railroads in Austria and Russia, and as the author of several important works, came to the United States in the autumn of 1838, intending to make himself acquainted with the public works, and principally the railroads in this country, and to publish, on his return to Europe, a large work on these interesting subjects. Desiring to communicate to the European public some of his observations, even during his journey, he wrote a series of letters, which were inserted in all the principal papers in Germany. One of these letters, containing a comparison of the railroads in Belgium* with those in the United States, has already been laid before the public in America, and from the general interest with which it was received, and its republication in so many periodicals, we may infer, that a translation of the other nine letters will be acceptable to the readers of the Journal.

Letter I.

Boston, January 15, 1839.

The rapid growth of the prosperity of the United States of North America, has excited, since many years, public attention in Europe, and I have

* See Journal Franklin Institute, vol. xxiv., p. 145.

been long desirous to visit that remarkable country. The long passage of sailing packets, however, has deterred me like many others; but what until lately was thought impossible—the steam navigation across the Atlantic—has been proved practicable in 1838, by the frequent, safe, and swift passages of the four English steamships. I left the Old World from Bristol, on the 27th of October, 1838, in the steamer Great Western, and arrived in New York on the 15th November, 1838. After a stay of one week in that city, I took a steamboat to Albany, on the Hudson river, from whence I proceeded to Buffalo, on Lake Erie, in order to inspect the canal between the two cities, as well as the several railroads in its vicinity. I then went to the Eastern States, and visited from Boston the different railroads and other improvements of this interesting country. My object was much forwarded by the kind reception I every where met with; but even without letters of introduction, every body, by the publicity which is so general here, may find much instruction and information, which he seeks in Europe in vain. On all public works a statement is annually made to the individuals concerned, and generally published and distributed in many copies. Railroad companies have to make annual reports to the legislatures from which they obtained their charters, and these reports are printed in Massachusetts, Virginia, and other states, for the instruction of the public, and a great many copies distributed. There can exist no doubt as to the accuracy of these reports, as they are certified by oath by the directors, when made to the state; but besides, there seldom exists any objection on the part of the managers, to open for inspection the books of public institutions.

There are three causes principally to which the United States owe their prosperity. The schools, which diffuse general knowledge, and enable every man correctly to judge of his enterprise, and to calculate the results; the banks, eight hundred in number, which procure every body the facility to raise funds proportionate to his ability, and enable him to enter into every speculation; finally railroads, canals, and steam navigation, which facilitate intercourse, in this immense country, in a manner, of which one can form only a very imperfect idea without having witnessed it. I commence my reports in an inverse order, speaking first of railroads and canals, in the following letters I will also treat of schools and banks.

Erie Canal, in the State of New York.

With the exception of only a few canals and railroads, all improvements of this kind originated within the last twenty years. The principal impulse to internal improvements was given by the results of the Erie Canal, the object of which, independently of the great local advantages, was to connect the fertile Western States of Michigan, Illinois, Ohio, and Indiana, and the western part of the state of New York, with the river Hudson, and thereby with the city of New York, the great commercial emporium of the United States. This canal extends from Albany, on the Hudson, to Buffalo, on Lake Erie, and is 363 miles in length; with its branches, 640 miles. On its length there are 394 locks, 72 aqueducts, and 1065 bridges: the main canal is 40 feet wide, 4 feet deep, and has single locks. The lateral canals are generally of the same dimensions. The construction of the canal was commenced on the 4th of July, 1817, and in October, 1825, the main line of 363 miles was opened. The expenses of construction of the main canal, and of the lateral canals, partly constructed afterwards, amounted to 12,000,000 dollars, and the greatest part of the capital was procured by

loans made by the state; but as it was feared, at first, that the tolls on the canal would not suffice to cover the interest on the loans, a tax was levied by the state from auctions, salt, and steamboats, and the proceeds thereof applied to the canal fund. From the period the canal has been partly put in operation, the annual receipts in tolls have been as follows, viz.

		On the Erie Canal alone.	On all the State canals.
In the year	1820	5,437	5,437
"	1821	14,388	14,388
"	1822	64,072	64,072
"	1823	152,958	152,958
"	1824	340,761	340,761
"	1825	566,113	566,113
"	1826	762,004	762,004
"	1827	859,058	859,058
"	1828	835,407	838,445
"	1829	795,054	813,137
"	1830	1,032,599	1,056,922
9 months ending Sept.	1831	833,349	854,288
Year ending Sept.	1832	1,060,221	1,086,434
"	1833	1,288,093	1,461,574
"	1834	1,178,298	1,338,393
"	1835	1,367,748	1,539,598
"	1836	1,434,030	1,607,295
"	1837	1,137,825	1,285,911
"	1838	1,405,182	1,581,386
		15,132,597	16,228,174

The annual expenses for collection and repairs amounted to about one-third of the revenue.

These numbers show, that the net profit of the canal has paid back, within a few years, the whole capital of construction, and that the state, therefore, by lending its credit for the completion of this large work, has not only increased the welfare and resources of the country, but created, besides, a source of considerable annual revenue.

The canal is at present navigated by 2500 boats, upon which 12,000 persons are engaged. But the rapid development of the Western States has so much increased the traffic upon the same, that an enlargement of the main canal, from 40 to 70 feet in width, and from 4 to 7 feet in depth, was thought necessary; as at the same time the locks, aqueducts, and bridges have to be reconstructed, the cost of the enlargement will exceed 20,000,000 dollars, and 5 or 6 years will be required for its completion.

Besides the enlargement of the main canal, two lateral canals are now in progress of construction, at the expense of the state. Their length is 167 miles, and their cost is estimated at 6,200,000 dollars; in a few years, therefore, the total length of the main canal and its lateral branches will be 807 miles.

Certainly, no other country in the world can boast of a canal of such length, which, completed in a few years, has given such immense results.

Railroads along the Erie Canal.

Besides produce and merchandize, passengers are also transported upon

the Erie Canal; but the latter accommodation having been found inadequate from the constantly increasing intercourse, chartered companies were formed within the last few years for the construction of a railroad in the valley of the canal. This railroad consists of the following seven sections, connected with each other, but each of them belonging to a separate company:

1. From Albany to Schenectady, already 6 years in operation,	16⅓	miles.
2. From Schenectady to Utica, since 2 years in operation,	77⅓	do.
3. From Utica to Syracuse, the grading finished, and only the iron bars wanting,	52¾	do.
4. From Syracuse to Auburn, 1 year in operation,	25¾	do.
5. From Auburn to Rochester, in progress of construction,	78	do.
6. From Rochester to Batavia, one year in operation,	32	do.
7. From Batavia to Buffalo, the construction to commence early in 1839,	36	do.
Total length,	318	miles.

The stockholders of these railroads are, for the greatest part, the farmers and mechanics of the respective counties, or the merchants trading in that vicinity. The profit arising to these classes by the construction of the roads is greater than the interest on their investments. For this reason the shares of two companies only are offered in the market, while the others are kept by the original subscribers.

It is an important feature of this and almost all other railroads in the United States, that they traverse the cities and villages situated on the lines, and lateral branches often lead through much frequented and populous streets; in the more densely peopled part of large cities, however, the use of horse power only is admitted. As in winter the snow often covers the whole country and the railroads frequently go through deep excavations, a suitable apparatus has been invented for clearing off the snow, and there is little difficulty in using the roads at all seasons. The railroads are travelled over day and night; in the latter, principally for the purpose of forwarding the mail without detention. A particular car (mail car) is employed in such cases, and forms the *travelling post office;* it consists of a heated room, occupied by a clerk of the Post Office Department, who, during the journey, distributes the letters obtained along the road in twenty or more boxes, from which they are taken and put in bags on approaching the respective places; the letter bag is then delivered and another received in exchange, for which operation never more than two minutes are allowed.

The cost of the several railroads differs much, according to the obstacles encountered in their location. But besides this, most of the companies, and principally such as are composed of the landholders on the line, have, as it were, appropriated a certain sum for the construction of the road, proportioned to the expected traffic upon the same, and it then became the affair of the engineer to make his plans accordingly.

The Americans prefer an inferior railroad, upon which they can travel with a speed of from 8 to 12 miles, to a common road, upon which they move with only half that speed; in America all such works are made in conformity with the local wants and circumstances, and never, as in the old world, planned after a universal model. Every railroad here shows, therefore, some peculiarities, and a judge of their true merits, can, in my opinion, learn more here in regard to internal improvements than in any

other country in the world. It will now be understood why, of the above seven railroads, the average cost per mile varies from 5,000 to 72,000 dollars, while the iron rails or bars are nearly on all of the same strength, in order that locomotive engines may be used upon them.

Other Railroads in the State of New York.

Besides the railroads above enumerated, the following are in operation in that state:—

From Schenectady to Saratoga,	21½	miles.
From Troy to Ballston,	25	do.
From Buffalo to Niagara Falls,	22¼	do.
From Niagara Falls to Lockport,	24	do.
From Ithaca to Owego,	28¾	do.
From Hudson to West Stockbridge,	34¾	do.
From Brooklyn to Hicksville,	26¼	do.
Some other short roads,	50	do.
Total length,	232½	miles.

The following are in progress of construction:

A railroad from the Hudson, near New York, direct to Lake Erie,	454	miles.
From New York, nearly parallel to the Hudson river, to Albany, to be used principally during the winter, when the river navigation is stopped,	147½	do.
From Catskill to Canajoharie,	72	do.
From Corning to the state line of Pennsylvania,	14½	do.
From Saratoga to Whitehall,	40	do.
Total,	728	miles.

With the above mentioned lines along the Erie Canal, there are, therefore, in total:—

Railroads completed,	384	miles.
Railroads in progress,	894¾	do.
	1278¾	miles.

To aid in the construction of these railroads, the State of New York has guaranteed the following loans:

1. To the New York and Erie Railroad Company, the State has promised already in the charter,	$3,000,000
2. To the Ithaca and Owego Railroad Company,	300,000
3. To the Auburn and Syracuse Railroad Company,	200,000
4. To the Catskill and Canajoharie do.	300,000
5. Besides to the Delaware and Hudson Canal Company,	800,000
Total,	$4,600,000

A part of these loans has been already realized, and the remainder is obtained as the works advance.

The total cost of all the railroads and canals, completed and in progress, in the State of New York, will amount to about 70,000,000 dollars, while the population of the State at the last census, in 1830, was only 1,918,608, and may now amount to 2,500,000. This gives, per head, an expense of 23 dollars for internal improvements.

Railroads in the State of Massachusetts.

The most solid railroads, and which compare best with the European structures, are those constructed in the State of Massachusetts. They are:

From Boston to Worcester,	44 miles.
From Boston to Providence,	41 do.
From Boston to Lowell,	26 do.
From Lowell to Nashua,	14 do.
From Lowell Railroad to Haverhill,	17 do.
From Boston to Salem,	13 do
From the Boston and Providence Railroad to Taunton,	11 do.
The following railroads are in progress of construction:—	
From Salem to Newburyport,	21 do.
From Worcester to Norwich,	60 do.
From Worcester to West Stockbridge,	117 do.
Total length of railroads in Massachusetts,	364 miles,

of which 166 miles are in operation.

The following loans have been granted by the State:

1. For the railroad from Worcester to West Stockbridge, the State subscribed one-third of the stock, and guaranteed a loan of	$2,100,000
2. For the railroad from Worcester to Norwich,	400,000
3. For the railroad from Boston to Newburyport,	590,000
4. For the Andover and Haverhill Railroad,	50,000
Total,	$3,140,000

The population of this State was, at the last census, (1830) only 610,408, and may now be about 700,000; if this number be compared with the amount of state loans, it shows that four dollars and a half per head were loaned for the construction of railroads. The loans of this State were negotiated in England; the last 5 per cent. loan brought a premium of 10 per cent.

The Railroad from Boston to Lake Erie, compared with that from St. Petersburg to Moscow to Colomna.

I cannot close this letter without making the following remarkable comparison. The railroad from Boston through Albany to Buffalo, on Lake Erie, will be completed within two or three years, and have a length of 519⅓ miles, or 775 Russian wersts. Boston, Albany, and Buffalo are situated in nearly a direct line, like St. Petersburg, Moscow, and Colomna. A railroad connecting the latter three cities, and extending to the river Oka, would also measure 774½ wersts, if its length is equal to that of the present

turnpike road. The object of the American railroad is the connexion of the fertile Western States with the harbour of Boston; that of the Russian, to connect the not less fertile country on the river Wolga, and the centre of the large empire, with the capital and harbour of St. Petersburg. In America, this long railroad was commenced in 1832, with the section from Albany to Schenectady, of 16 miles in length; in Russia, the great work was begun in 1836, with a railroad of equal length between St. Petersburg and Zarskoe-Selo. The American railroad was undertaken by private individuals, with the assistance of the States; what should prevent the accomplishment of a similar project in Russia, where the greatest monuments of the age have already been erected by Peter the Great and his successors?

Letter II.

Finances of the State of New York.

Philadelphia, February 22, 1839.

The State of New York is the most prosperous and populous amongst the 26 States at present forming the Union, although in the extent of the surface it is exceeded by eight other States.

The area of New York is 46,200 square miles: its population was in the year

1790,	340,120,	and the whole population of the U. States,			3,929,827
1800,	586,756,	do.	do.	do.	5,305,925
1810,	959,949,	do.	do.	do.	7,239,814
1820,	1,372,812,	do.	do.	do.	9,638,131
1830,	1,918,608,	do.	do.	do.	12,866,920

I have stated in my first letter, that the State of New York gave the principal impulse to the construction of canals and railroads in the United States, by the completion of the grand Erie Canal. Upon this canal there are now annually transported produce and merchandize of twenty-two millions in value, and 700,000 tons in weight; the tolls have paid back the capital invested in its construction, and yield at present a surplus for the State treasury. The property in the vicinity of the canal rose to at least five times its former value, and village after village originated on its borders, like the city of Rochester for instance, which now contains 20,000 prosperous inhabitants, while in 1812, only a few log huts were visible amidst the woods. Nothing but such an example was required to give rise to numerous projects for canals and railroads all over the Union, of whose magnitude and consequence for the prosperity of the country, no correct idea can be formed in Europe.

In the year 1838, the Legislature of the State of New York appointed a committee to inquire into the finances and the prosperity of the State, and to report whether the Legislature ought to appropriate further sums for internal improvements. The report of this committee, as also the annual report of the Comptroller of the State, have lately been published, and contain the following interesting data:

The annual expenses of the State Government amount to 400,000 dollars.

They comprise the salary of the Governor, 4000 dollars, of the Auditor, 2500 dollars, of the Secretary of State, 2500 dollars, and of the Comptroller, 2500 dollars: the other State officers receive smaller salaries; most of the other expenses are incurred by the Legislative Assembly and the Courts. Until 1826, a tax had been levied from all real and personal property, to defray the expenses of the State Government; since that time, or since thirteen years, this tax was discontinued, and the expenses of the State Government are defrayed only from a tax imposed on public auctions, and the duty on salt.

The State of New York had, on the 1st of January, 1837, 977,532 dollars of old debts, and 3,555,224 dollars debts for new canals, amounting together to 4,532,756 dollars, while the surplus revenue from canal tolls, after deducting the expenses for collection and repairs, amounted in one year, to 1,107,871 dollars. This surplus revenue is equal to the interest, at 5 per cent., on a capital of 22,157,420 dollars; and after deducting the above debt of 4,532,756 dollars, there still remain 17,624,664 dollars as the productive funds of the State. It had besides, on the 30th September, 1838, a fund of 1,929,707 dollars for common schools, and one of 268,093 dollars for the maintenance of schools for the higher branches of education; finally, in 1837, the State received from the General Government its share out of the surplus revenue of 42 millions, to the amount of 4,014,520 dollars, which sum has meanwhile laid on interest.

For the maintenance of roads, charitable institutions, schools, &c. in the towns and districts, a tax is levied, through the whole State, from all real and personal property; and the latter, therefore, assessed annually by a committee appointed for that purpose. This real and personal property amounted,

In 1820, to - -	255,552,365	dollars.
1830, to - -	319,118,296	do.
1838, to - -	627,544,784	do.

and the whole tax thereon was, in 1838, 2,860,476 dollars.

Supposing the population of New York in 1838, at 2,500,000, the property per head amounted to 251 dollars, which is rather below the actual amount, as in all such cases, when done for the purpose of taxation, the property is assessed below its value. Of this considerable property, the taxes in 1838, were only $1 14 per head.

Under these favourable circumstances, the committee appointed by the Legislature proposed an annual appropriation of four millions of dollars, during the succeeding ten years, or in the whole, of forty millions of dollars for the construction of railroads and canals.

The most Expensive Railroad in the United States.

In Europe the opinion prevails, that the American railroads are all of an inferior construction, with weak iron bars, short curves, and steep grades; that in constructing them only cheapness and economy were kept in view, and therefore they cannot be regarded as examples for imitation in Europe. I have already, in a former letter, explained my views on the American railroads, and after having, within the last three months, travelled over 24 railroads, of an aggregate length of 750 miles, inspected their construction, and made extracts of the accounts of their operations, I do not hesitate to repeat, that the system of the American railroads, constructed as they are, in a climate similar to that in Germany, and used in winter as

well as in summer, appears to me more worthy of imitation in Germany and in Russia, than the English railroads, and that an engineer can undoubtedly acquire more experience here, than any where else, provided he is able to find out, amongst the numerous experiments made here on every branch of construction, what is good and approved.

Wherever it was not necessary, the Americans have not economised in the construction of their railroads; this has been proved principally in the establishment of a railroad within the city of New York. This city is located upon an island, extends about eight miles to the Harlaem river, and has an average width of two miles only. The lower, or southern, part of the city contains now a population of 300,000, and as the annual increase in the number of inhabitants is nearly 15,000, requiring from 800 to 1,000 new houses, the northern parts of the city must constantly become more and more built up, and inhabited. The property owners in these parts of the city, united, therefore, eight years ago, and subscribed the capital for a railroad, commencing in the most populous part of the city, (near the City Hall) and extending through several streets, and the still unimproved grounds, to the last buildings on the Harlaem river, or to 133d street. The railroad has a double track, and is built five miles in a straight line, with very easy grades, to attain which, a tunnel had to be excavated through a very hard rock; and amongst other bridges, one with four spans, (the largest of 175 feet) the piers and abutments of stone, to be constructed. The iron bars weigh only 15 lbs. to the yard, notwithstanding which, the expenses of construction amounted, at the close of 1838, to 1,060,000 dollars, and will, after the entire completion, probably not fall short of 1,200,000 dollars. The cost of this road per mile, will therefore be 150,000 dollars; to which must be added the cost of exchanging the flat bars for heavy iron rails, weighing probably 58 lbs. per yard, like those on several railroads in Massachusetts. This important railroad, called the New York and Harlaem Railroad, has been traveled over last year by 800,000 persons, and serves, at it were, as an omnibus within the limits of the city of New York; upon one-third of its length, horse power is used; and upon the remainder two-thirds, locomotive engines are employed. The construction of such a railroad certainly shows that the Americans expend large sums where it is necessary; but how much the introduction of railroads has been facilitated in this country, the number of locomotives manufactured here within the last few years will show.

Steamboats, Locomotive Engines, and Stationary Steam Engines, in the United States.

The Secretary of the Treasury has lately made to Congress a very interesting report on these subjects. This report, which contains 472 pages, is founded upon official information up to the summer of 1838; according to the same, there were in the United States,

Steamboats built since 1807,	- -	1300,
Of which have been worn out,	- -	240
Lost by accidents,	- - -	260
And are still in use,	- - - -	800
Tonnage of all steamboats,	-	155,473
Horse power of the engines of the same,		75,019

The largest steamboat is the Natchez, of 860 tons, and 300 horse power. As fuel, wood is principally used.

Although many steamboats are propelled by two engines, each boat appears in the list with only one machine; therefore all

800 steamboats with - - -	800	steam engines;
To which the number of locomotives, -	350	do.
And in factories, &c., - - -	1860	do.
Total number, - -	3010	steam engines.

According to a report published in 1836, there were at that time in England only 600 steamboats, with a tonnage of 67,969. In France, the number of steamboats is much less.

The above mentioned 350 locomotives are used upon 54 railroads; the greatest number of locomotives is upon the Philadelphia and Columbia Railroad, of 82 miles in length, viz. 34.

The following statement is extracted from the Report of the Secretary of the Treasury:

Year.	Number of Locomotive Engines.		Total.
	Imported from England.	Manufactured in America.	
1831	1	0	1
1832	8	3	11
1833	13	4	17
1834	11	22	33
1835	19	36	55
1836	12	81	93
1837	20	76	96
1838	0	44	44
Total,	84	266	350

This remarkable statement shows best how soon American ingenuity succeeds in supplying the wants of the country; in 1831 the first locomotive engine was imported from England, because they could not manufacture it in America; but seven years later the English were driven from the market, and locomotives are now constructing in twenty-one American manufactories. Two locomotives have been sent already from here to Austria, one to Brunswick, and the day before yesterday, the first American locomotive engine, from the manufactory of Mr. William Norris, in Philadelphia, was shipped for England, to which nine others are to follow. There could indeed be no greater triumph for American machinists, than this order from England for ten locomotives!

Mr. William Norris, in Philadelphia, has, up to the 20th of February, 1839, constructed 73 engines, and Mr. M. W. Baldwin, up to the same day, 120; each of these manufacturers employs in his shop 250 workmen, and is so established as to be able to deliver one engine every week. The price of a locomotive engine, with tender, in both manufactories, varies from 7000 to 8000 dollars, according to the dimensions.

In the above statement, Mr. Norris appears only with 36, and Mr. Bald-

win with 91 engines, as the data reached only to the middle of 1838; the former has since that constructed and put upon the railroads in America, 31, and the latter 27 engines; and as at the same time other manufactories have also delivered several new locomotives, it may be asserted, that there are at present upon the railroads in the United States, 425 locomotive engines, of which only 84 were imported from England, and the remainder constructed, all within the last seven years, in this country. We may, therefore, justly anticipate, that the Americans, by prosecuting the improvements already commenced, will attain, in the construction of locomotive engines, a high degree of perfection, and supply Europe with many and good machines.

TO BE CONTINUED.

NOTE.—The article on the Railroads of the United States, published in our last number, was credited to the Chevalier de Gerstner by mistake; the name of Mr. L. Klein should have appeared as the author.

COM. PUB.

Railroads in the United States. By L. KLEIN, *Civil Engineer.*

These articles will contain a list of all railroads constructed, or in progress of construction, in the United States, up to the end of the year 1839, their names and direction, their length, the number of miles in operation, and in progress, the description of iron used thereon, the motive power used, and the number of locomotives employed; the amount expended, and that required to complete them; and finally, their total cost of construction, and the average cost per mile of each road.

No. 1.

Railroads in the State of New York.

The railroads in the State of New York have all been undertaken by private companies, and the capital necessary for their construction was partly paid in shares by private individuals, (stockholders) and partly obtained by private loans, contracted by the companies, when the amount of capital paid in was found inadequate to complete the works. Loans have been granted by the State to a few railroad companies, or rather the State issued its bonds to a certain amount, which were given to, and then sold by, the respective companies. With the exception of the Mohawk and Hudson and the Harlaem Railroads, all those in the State of New York have but a single track. The superstructure is of wood, with a flat iron bar fastened upon longitudinal string pieces, except in the Long Island Railroad, where a heavy T rail is used. The motive power is steam, a few short lines excepted, where horses are employed; and upon some certain roads which are but little frequented, horses are used in winter, when the expense of running locomotive engines would exceed the receipts from the traffic. The railroads constructed along the line of the Erie Canal are not allowed to carry freight, except by paying to the State the same amount of toll as is charged upon the canal; all other railroads carry freight and passengers, but derive their profit almost exclusively from passengers, the quantity of freight transported being so small, that the expenses incident thereto do not fall much short of the gross receipts.

List of Railroads completed or in progress in the State of New York, at the close of 1839.

No.	Name of Railroad.	From and to where.	Opened. Year.	Opened. Miles.	No. miles. graded.	No. miles. Not yet graded.	Total length of road.	Dimensions or weight of iron bars or rails.	Motive power employed	Amount of capital expended.	Amount wanted for completion.	Total cost of railroad	Cost per mile.
							miles	inch.		Dollars.	Dollars.	Dollars.	Dollars
1	Mohawk and Hudson,	Albany to Schenectady	1832	16½			16½	flat bar 2½×9-16	4 locomt.	1.136.000		1.136.000	69.735
2	Utica and Schenectady,	Schenectady to Utica	1836	77½			77½	do. 2½×¾	} 12 do.	1.850.000		1.850.000	23.922
3	Syracuse and Utica,	Utica to Syracuse	1839	52½			52½	do. 2½×¾		912.000	50.000	962.000	18.237
4	Auburn and Syracuse,	Syracuse to Auburn	1837	25¾			25¾	do. 2½×¾	3 locomt.	630.000		630.000	24.466
5	Auburn and Rochester,	Auburn to Rochester			25	53	78	rail 40lb intended		230.000	1.270.000	1.500.000	19.231
6	Tonawanda,	Rochester to Batavia	1837	32			32	flat bar 2½×⅝	3 locomt.	575.400		575.400	17.981
7	Buffalo and Niagara Falls,	Buffalo to Niagara Falls	1837	22 3/16			22 3/16	2½×½	3 locomt.	165.000		165.000	7.437
8	Buffalo and Blackrock,	Buffalo to Blackrock	1834	3 1/16			3 1/16	2 ×½	horses.	20.000		20.000	6.531
9	Lockport and Niagara Falls,	Lockport to Niagara Falls	1837	24			24	2½×⅝	2 locomt.	195.000		195.000	8.125
10	Lewiston Branch,	Lewiston to Lockport and Niagara Falls Railroad	1837	3⅓			3⅓	2½×⅝	horses.	27.000	3.000	30.000	9.000
11	Medina and Darien,	Medina to Pembroke	1836	20			20	0*	horses.	40.000		40.000	2.000
12	Rochester,	Rochester to Carthage	1833	3			3	2×½	horses.	30.000		30.000	10.000
13	Scottsville and Caledonia,	Scottsville to Caledonia	1838	8			8	0	horses.	32.000		32.000	4.000
14	Skeneateles,	Skeneateles to Auburn & Syracuse Railroad			3	2¼	5¼	0	horses.	7.500	22.500	30.000	5.714
15	Syracuse and Onondaga,	Syracuse to Onondaga Quarries,	1837	4½			4½	2½×⅝	horses.	49.250		49.250	10.944
16	Schenectady and Saratoga,	Schenectady to Saratoga Springs	1832	21½			21½	2½×9-16	2 locomt.	302.500		302.500	14.070

* This railroad has no iron, and the cars run upon wooden ribbons; it is the same case with the Scottsville and Caledonia, and the Skeneateles railroads.

List of Railroads completed or in progress in the State of New York at the close of 1839.—*Concluded.*

No.	Name of Railroad.	From and to where.	Opened. Year.	Opened. Miles.	No. miles. graded.	No. miles. Not yet graded.	Total length of road.	Dimensions or weight of iron bars or rails.	Motive power employed	Amount of capital expended.	Amount wanted for completion	Total cost of railroad.	Cost per mile.
							miles.			Dollars.	Dollars.	Dollars.	Dollars.
17	Saratoga and Washington,	Saratoga to Whitehall			10	30	40			60.000	440.000	500.000	12.500
18	Rensselaer and Saratoga,	Troy to Ballston	1835	25			25	flat bar, $2\frac{1}{4}\times\frac{5}{8}$	2 locomt.	487.000		487.000	19.480
19	Hudson and Berkshire,	Hudson to West Stockbridge	1838	$34\frac{3}{4}$			$34\frac{3}{4}$	$2\frac{1}{2}\times\frac{5}{8}$	3 locomt.	500.000	40.000	540.000	12.662
20	Cattskill and Canajoharie,	Cattskill to Canajoharie	1838	15*	11*	46	72	$2\frac{1}{4}\times\frac{5}{8}$	1 locomt.	300.000	700.000	1.000.000	13.889
21	Ithaca and Owego,	Ithaca to Owego	1834	$28\frac{3}{4}$			$28\frac{3}{4}$	$2\frac{1}{4}\times\frac{5}{8}$	1 locomt.	575.400		575.400	20.000
22	Corning and Blossburg,	Corning to Pennsylvania State Line			$14\frac{1}{4}$†		$14\frac{1}{4}$	$2\frac{1}{4}\times\frac{3}{4}$	& horses. 2 locomt.	150.000		150.000	10.526
23	New York and Erie,	Tappan to Dunkirk			103	351	454			700.000	4.300.000	5.000.000	11.013
24	New York and Albany,	New York to Albany			4	$143\frac{1}{2}$	$147\frac{1}{2}$			50.500	2.742.500	2.800.000	18.983
25	New York and Harlaem,	New York to Harlaem	1839	8			8	$2\frac{1}{2}\times\frac{5}{8}$	4 locomt.	1.150.000	20.000	1.170.000	146.250
26	Brooklyn and Jamaica,	Brooklyn to Jamaica	1836	11			11	rail, 38 lbs.	3 do.	404.400	15.000	419.000	38.127
27	Long Island,	Jamaica to Greenport	1837	$15\frac{1}{4}$		68	$83\frac{1}{4}$	58 lbs.	3 do.	732.850	900.000	1.632.850	19.614
28	Hempstead Branch,	Long Island Railroad to Hempstead	1839	$2\frac{1}{4}$			$2\frac{1}{4}$	bar, $2\frac{1}{4}\times\frac{5}{8}$	horses.	13.000		13.000	5.778
28	Railroads.			$453\frac{3}{4}$	$170\frac{1}{4}$	$693\frac{3}{4}$	$1317\frac{3}{4}$		45 locom.	11.331.800	10.503.000	21.834.800	16.570

* Of the Cattskill and Canajoharie Railroad, 26 miles are now in operation.

† The Corning and Blossburg Railroad is now opened; other $25\frac{1}{4}$ miles of this road are in Pennsylvania.

From the preceding table, we draw the following conclusions:

1. The railroads in the State of New York have been constructed by twenty-eight different companies; the first five form a continuous line of two hundred and eighty-two miles, of which two hundred and four miles are now in operation; when the railroad from Batavia to Buffalo, for which a charter has been obtained, shall have been constructed, there will be an uninterrupted railroad from Albany to Niagara Falls, of three hundred and sixty-four miles, equal to the length of the Erie Canal.

2. The *longest* railroad in the State, *completed* by one company, is that from Utica to Schenectady, and the *oldest* the one from Albany to Schenectady; in the same year with the latter, (1832) the continuation to Saratoga Springs was also put in operation.

3. The number of miles of railroads opened at the end of 1839, were $453\frac{3}{4}$, the number of miles prepared for the superstructure were at the same time $170\frac{1}{4}$, leaving on all the lines undertaken, $693\frac{3}{4}$ miles yet to be constructed; the total length of all the twenty-eight railroads will then be $1317\frac{3}{4}$ miles.

4. The number of railroads upon which locomotive engines are used is sixteen, and their length $423\frac{3}{4}$ miles, including the Blossburg railroad; the number of locomotives employed is forty-five, being at the rate of *one locomotive engine for* $9\frac{4}{10}$ *miles of road.*

5. The total amount of capital expended for railroads, at the end of 1839, was 11,311,800 dollars; the amount yet to be expended, 10,502,500 dollars, which will make the total cost of the twenty-eight railroads, when completed, equal to 21,814,800 dollars, and the *average cost per mile*, 16,570 *dollars*. The amounts required for completion are taken from the latest estimates of the engineers, and may, in some cases, be exceeded. Of the twenty-eight railroads, however, twenty-one are entirely finished; their aggregate length is $438\frac{1}{2}$ miles, and their total cost, 8,231,950 dollars; this gives, at an average, 18,773 *dollars per mile* of road, with a single track, including buildings and outfit.

TO BE CONTINUED.

Bibliographical Notices.

A Description of the Canals and Railroads of the United States, comprehending Notices of all the works of Internal Improvement throughout the several States. By H. S. Tanner. New York: Tanner & Disturnell, 1840. 8vo. p.p. 272.

We deem this book to be one of no common value to every person, be his habits locomotive or stationary, who feels an interest in the vast improvements which have distinguished the last quarter of a century in these United States. Lives the man, possessed of an ordinary share of curiosity, who can be content to *hear tell* of the great Erie Canal, of the warfare in Congress about the Cumberland Road, or of the prospect of being able to travel from Bangor to Pensacola, or New Orleans, and thence to Detroit or the Wisconsin River, without the necessity of leaving his cushioned seat in a beautiful railroad car, except to take the needful refreshments,—and yet feel no desire to have the particulars of this mighty progress? What history or what facts can be more interesting than those which relate to the triumphs of genius and art over the most formidable obstacles which rise in

opposition to the free and universal intercourse of man with man? We were forcibly struck the other day with one historical fact in relation to traveling, which finely contrasts with our present capacities. When Guy Fawkes was caught at midnight in the cellar of the Parliament House, with his dark lanthorn and matches in readiness to fire the train, and with his cloak and boots on, ready to escape to associates in the country, the city of London was thrown into the utmost tumult, as the news of the gunpowder plot flew from street to street. Several days elapsed before he made a confession of the extent of his guilt, and the names of his companions. The conspirators, to the number of eight, met at a house in Staffordshire, just about one hundred miles from London, and such was the rate of traveling at that period, although a trumpeter was sent in haste with a warrant to the Sheriff of the county to arrest them, it was not till *three days after* that the Sheriff heard of the conspiracy and received his order. The roads, it is acknowledged, were bad, and "traveling by night at that time was never contemplated."*

Next to the pleasure of traveling at the rate of twenty miles an hour in a joltless vehicle, amidst magnificent scenery, is that of having a good guide book and map in hand, to inform one of the names of the towns, rivers and mountains which constitute the objects of the moving picture which is thus flying around us, and captivating and tantalizing our vision. To pass along with our eyes shut, regardless of the means by which we are thus transported, and of the immense labour, cost and ingenuity by which this astonishing time-saving and world-changing scene has been accomplished, is as stupid as traveling from Dan to Beersheba, and calling it all barren. Not the least of the enjoyment is the consciousness that the increased rapidity of our movements is not gained at the expense of the sweat and sinews of that noble animal, of whose lives and hardships all stage competition has hitherto been so regardless. But by what means is all this effected? What is a locomotive, or railroad steam engine? What is the *power* that thus carries us with the swiftness of the wind—almost reckless of the weight which it draws after it? How is a locomotive constructed? What is the nature of the difficulties in railroad making—and what the cost in any particular place? Can any one pass through the great tunnel on the Reading road, and learn that in carrying it through the mountain, the candles alone cost about $4000, without wishing to be informed of other particulars relative to time, labour, cost and contrivance? What proportion of those who travel know beforehand, that *canals*, as well as roads, have to be carried across rivers on *bridges*, exhibiting the phenomena of boats sailing over the topmasts of other boats? As one of the most rational objects in traveling is to add to the stock of our intelligence, it is surely of importance that every facility should be sought for, and one of the best of these is a good itinerary or guide book. It was on this account that we hailed with pleasure the appearance of the work before us. No one, we are persuaded, could have undertaken such a task with more of the true *gusto* of compilation than the author himself, already a veteran teacher of map geography, whose praise is in all the schools.

In a very suitable introduction to the statistical part of the work, it is justly remarked that:

"Whatever may be the condition of other portions of the civilized world with regard to these important modes of intercommunication, we, in this country, may boast of our superiority, not only in the extent to which the

* A Complete History of the Gunpowder Treason, A. D. 1605, by Rev. T. Lathbury, M.A

system has been carried here, but also in the admirable formation of its various lines; and, what is of infinite importance, in the structure and management of the locomotive engine. Among us, the spirit of improvement is no longer confined within the limits of our populous states, but, like their restless inhabitants, has found its way to the remotest corners of the republic, where its influence is equally felt and appreciated, and where the system will become as universal as it is beneficial.

"This general extension, actual and prospective, of canals and railways in the United States, is one effect of that enlightened constitution of government which the Revolution has confirmed to us, and which impresses an indelible mark of distinction between the enterprizing American and the plodding inhabitant of the other hemisphere. In most other countries, the great mass of the people, being destitute of wealth, have but little influence, and still less power to effect important objects; hence every work requiring large expenditure, must be accomplished by the wealthy few, whom it is well known do not always consist of the most enterprising portion of a community. Here it is essentially different; wealth and information being more generally diffused among the great body of the people, they possess and exercise a powerful influence in all affairs of a public nature, and of course claim a large share of attention. To the *people* of the United States, then, is the great system of internal improvement confided.—To this system, therefore, men of learning and influence now direct their attention, as the *people*, in the most comprehensive sense of the term, are to derive the advantages which must result from its general adoption."

The book is not confined to a description of the roads and canals actually in operation. Four of the great lines of intercourse which have been clearly marked out, and wait only the return of renewed commercial prosperity, are also very properly delineated, thus furnishing a more interesting view of what the country will be in the course of a few years of returning wealth and activity.

"The description of those works now offered to the public, differs in several points from other books on the same subject. Besides exhibiting an easy, distinct, and systematic account of the existing works of internal improvement, we have endeavoured to describe those merely contemplated, which are likely to be constructed soon. The value and importance of canals and railways depend on a combination of circumstances, which reciprocally affect each other. There is a nearer connexion between works situated apart and distant from each other, than most people seem to apprehend. In a work of this kind, the object of which is to develop the moral, political, and commercial effects of the system of internal improvement in our country, none of these topics should remain unnoticed. The omission of any one of them would, in reality, deprive us of a branch of knowledge, not only interesting in itself, but which is absolutely necessary to enable us to form a just conception of the subject in general. We have therefore thought it necessary that our work should embrace the history and present condition of the canals and railways in every state and territory of the Union, with the particulars and details belonging to each. This will, on reflection, appear necessary, when we consider the powerful influence of the system upon the habits and pursuits of a vast number of our people."

The "Introduction" is followed by a "General View" of the great system of internal improvement now in operation and in project throughout the country. A map of the United States, on a scale of convenient size,

exhibits to the eye the progress that has been made, as well as the roads and canals in different states of forwardness, and those which are still waiting for funds. Of the great routes, the author tells us:

"The first great chain of railroad, of which those just mentioned form a part, is that commencing at Portsmouth, in New Hampshire, and extending, with an occasional interval, through the Atlantic states to Pensacola, in Florida. From Portsmouth, the Eastern Railroad extends to Boston, whence the line is continued, by the Boston and Providence Railroad, to Providence, where it meets the railroad to Stonington, in Connecticut. From Stonington, after crossing Long Island Sound to Greenport, on Long Island, the line is resumed, and proceeds to Brooklyn, opposite New York, by the Brooklyn and Long Island Railroad, about 28 miles of which are completed and in use; the remaining 72 miles are now in progress. Crossing the East River to New York, and thence over the Hudson to Jersey City, the line is continued by the New Jersey Railroad to New Brunswick, thence by the Trenton and New Brunswick Railroad to Trenton, and thence to Philadelphia, by the Philadelphia and Trenton Railroad. From Philadelphia it proceeds to Baltimore, by the Philadelphia, Wilmington and Baltimore Railroad, and thence to Washington, by the Washington branch of the Baltimore and Ohio Railroad. The road from Washington to Fredericksburg, in Virginia, though proposed, is not yet commenced. At Fredericksburg the line is resumed and proceeds to Richmond, by the Fredericksburg and Richmond Railroad, thence to Petersburg by the Richmond and Petersburg Railroad, thence by the Petersburg and Roanoke Railroad, to Gaston, in North Carolina, thence by the Raleigh and Gaston Railroad to Raleigh, whence it is proposed to construct a railroad to Columbia, in South Carolina. From Columbia, by the Columbia branch of the South Carolina Railroad, the line is conducted to Branchville, and thence by the main line of the South Carolina Railroad, to Augusta, in Georgia. At Augusta commences the Georgia Railroad, which extends to De Kalb county, whence a road to West Point, on the Chattahooche, is in progress. From West Point the line proceeds along the Montgomery and West Point Railroad to Montgomery, in Alabama, and thence by the Alabama, Florida and Georgia Railroad, to Pensacola in Florida. In the entire length of this extensive line, there are but four sections wanted to render it complete, viz. one from Greenport to Hickstown, Long Island; one from Washington to Fredericksburg; one from Raleigh to Columbia; and one from De Kalb, in Georgia, to West Point. The aggregate length of these railroads, nearly all of which are completed, and in use, is 1600 miles. Should the state of Virginia execute her projected railroad from Richmond, via Abingdon, to the Tennessee line, a route to New Orleans will be effected by means of the Highwassee, Knoxville, and Nashville, and the New Orleans and Nashville Railroads, now in progress."

Connected with this great Atlantic line, are eight other routes of national importance, described in the General View.

"Thus, it will be perceived, that the entire surface of our country is now, or will be shortly, intersected by canals and railroads in almost every direction; and the West will ere long present a spectacle equally cheering to the friends of internal improvements. As facilities of intercourse, the moral effects of the general introduction of railroads and canals can never be duly appreciated. Considered as means of revenue, merely, it is doubtful whether they can be made to yield an interest equal to that derived from most other investments. With regard to the canals of any country, taken

in the aggregate, their average income falls considerably short of the current interest of the country. Some of the canals of England, those of Coventry, Erwash, and Laughboro, for example, yielded in 1822, an average annual interest of upwards of one hundred and twelve per cent. on their cost; whilst others scarcely defray their ordinary expenses. The average receipts from the New York State Canals for the last three years, have yielded an interest on these of about eight per cent. And the principal Canals of Pennsylvania, for the same period, have produced nearly six per cent. The tolls for the last fiscal year, ending on the 31st October, 1839, were on all the canals $542,386 63; on railroads, (Columbia and Portage) $319,622 88; on motive power, $280,123 53; total, $1,142, 633 04, which exceeds the annual aggregate of the preceding year, by $151,380 62. The railroads throughout the country will, no doubt, prove hereafter to be more productive than the canals; though, according to a statement drawn up by Mr. De Gerstner, the interest on the capital invested in railroads in 1839, does not exceed five and a half per cent. per annum."

Besides the general map of the United States, there is one of the State of New York, one of the State of Pennsylvania, and two others exhibiting profiles of the elevations and distances of some of the chief canals and railroads. The materials of the work are evidently drawn from the most authentic sources—the official reports of engineers, and other public documents.

We could have wished that the author had furnished his book with a few more state maps, especially of some of the larger members of the Confederacy. We are not, however, disposed to complain, inasmuch as the general map of the United States is on such a scale as pretty well to supply the deficiency.

But the volume before us is not intended merely, or even chiefly, as a guide book to the traveler, while on his journey. It is designed for the library—for satisfying the inquiries of all who wish to be well informed in relation to the internal improvements completed or in progress throughout the national domain; and we know of no other work so well adapted to the purpose. As a hand-book in traveling, it is perhaps rather too large—and besides, there are few travelers who set out on such extensive journeys as to need as a *vade mecum* a description of more than one or two of the great routes through the country. We still think, therefore, and have so expressed it in our Journal, that a person, qualified as our author is, would do a most acceptable service to the public, by publishing separate itineraries of each of the most frequented routes, accompanied with a *map of the road* over which he is passing, and detailing the most interesting particulars of its construction and of the places passed through. Such guides we think would find a ready sale, at the depots, and even in the cars on the route. The map should occupy one side of the page of the book, and might very well be engraved on wood, and printed in successive portions with the page.

Separate guide books, of the kind now suggested, would by no means supersede the utility of the valuable work under review, and we cannot conclude our notice of it, without observing, that in addition to its statistics of all the principal railroads and canals in the country, about 30 pages at the conclusion are very judiciously occupied with a "Glossary of the scientific, mechanical, and other terms employed in engineering,"—terms which, in these railroad times, must become, to those who would converse intelligibly, almost as household words. G.

Memoir on the Propagation of Heat in Liquids. *By* M. C. Despretz. (*Ann. de Chem. June*, 1839.)

After citing the experiments of Count Rumford, as described in his Essays, vol. ii., and those of Dr. Thompson, in Nicholson's Journal, and inferring, justly enough, that neither of them were at all decisive of the question, the author brings into view the better devised experiments of Dr. Murray, of Edinburg. In all preceding attempts to ascertain whether heat can be propagated downwards in a liquid column, the objection appeared to be valid, that in every appearance of an actual transmission downwards, the sides of the vessel might be the conducting medium, and not the liquid itself. To remove this doubt, Dr. Murray ingeniously thought of the scheme of forming a cylinder of ice, which of course is a perfect non-conductor of heat above 32° Fahr. His results have been considered as having satisfactorily determined the reality of a downward transmission of heat in liquids, and of course the conductibility of heat of bodies in the liquid as well as in the solid state.

But Dr. Murray's experiments did not determine the law of transmission, and this was one object in the experiments of M. Despretz. He remarks, that in a prolonged discussion, to which his researches had given rise, in the Philomathic Society, the name of Fourier had been invoked, and he cites the following paragraph of that "illustrious geometer":

"The coefficient which measures the proper conductibility of the mass (liquid) has not a value entirely null; but this coefficient is very small. We have very few experiments on this subject. Those which we undertook a few years ago, proved to us that liquids are not destitute of the property of transmitting heat, and that the various kinds possess this property in quite different degrees. But it always appears to us, that the value of the coefficient is very small, so that changes of temperature are almost entirely determined in liquids by interior motions. The effect of communication is not null or almost insensible, as Count Rumford supposed, but it certainly has a very slow influence over the distribution of heat."

If heat be applied to the upper surface of a liquid column, the temperature of which is above that of the maximum density of the fluid, which, in the case of fresh water, is about 4° C. = 39¼ F., and it is found that the temperature increases downward, it is obvious that this cannot arise from evection or the motion of currents, and therefore there can be no question of the conductibility of the liquids, or the transmission of caloric from particle to particle, as in the case of solids. It was with a view to furnish another experimental proof of this fact, and also to determine the law, that the author instituted his inquiries.

His apparatus consisted of a wooden cylinder, about eight and a half inches in diameter, and 39 inches high. The bottom was of tinned copper, which was kept in contact with water of the constant temperature of the room. The thickness of the wooden side of the cylinder was about one inch and a quarter. Twelve thermometers were introduced into the axis of the vessel, horizontally, passing through holes in its sides. The reservoirs of the thermometers were about 2.8 inches in length—the upper one was at a distance of 1.8 inches from the source of heat, and the upper six were about the same distance from each other, while that of the other six was double. A vessel of thin copper, about 10 inches high, was placed on the upper part of the cylinder, into which, during the experiment, boiling water was in-

troduced by a tube proceeding from another room, and which was conveyed back again by another tube, the vessel being replenished with boiling water every five minutes, thus preserving the temperature of the heating source uniform, as well as that of the room of the experiments.

The experiment continued 32 hours, and at the end of 24 hours, the temperature of the whole column became stationary, and continued so to the end. The first six of the thermometers only indicated any rise of temperature, the next and succeeding not being affected.

The medium of the last six hours being taken as the statical condition of the column, the result of the experiment was as follows:—

Temperature of the room, 8°.78 C. = 47°.80 Fahr.

	Temperature.	Expanse of the air.
1st thermometer,	46°.37	37°.59
2nd do.	33 .10	24 .32
3d do.	23 .46	14 .68
4th do.	18 .30	9 .52
5th do.	14 .44	5 .66
6th do.	12 .23	3 .45

Several of the learned members of the Academy, who acknowledged the importance of these results, having expressed the fear that the envelope of the liquid column might have contributed to the propagation of the heat, M. Despretz was induced to repeat the experiment with a cylinder of nearly double the size of the former, namely, about 16 inches in diameter, with the addition of several thermometers placed very near the side of the tub, and three others with their reservoirs within the substance of the tub itself, in oblique cavities made for the purpose, and sealed up with wax.

The experiment continued 60 hours, and it was found that the temperature decreased from the axis of the column to the circumference, and from that to the interior of the wooden envelope, thus obviating the objection made to the former experiment, and evincing that little or no allowance was to be made for the conducting power of the tub. The heat descended farther in the large column than in the smaller, but the progression appears to have been at the same rate.

On comparing the progression with the formula given for the progress of heat along a metallic bar, M. Despretz finds them to be the same, and he thus sums up the conclusions deducible from his experiments:—

"1st. In a liquid cylinder, heated at the top, the heat is propagated so as to give an excess of temperature over that of the surrounding air, at equidistant points in the axis, which is in geometrical progression.

"2nd. The temperature in the same horizontal line decreases from the axis to the circumference, and from thence to the envelope, proving that the envelope had no effect on the heat of the liquid.

"3d. Experiments made with cylinders of different diameters, satisfy the law which connects these diameters with the quotients of the geometrical progression for solid bodies.

"The natural and necessary conclusion is, that the propagation of heat from top to bottom in liquids, takes place according to the laws which regulate its progression in solids, or, in other words, radiation takes place from particle to particle." G.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1839,
With Remarks and Exemplifications by the Editor.

1. For an improved *Cooking Stove;* Hiram Root, Deerfield, Franklin county, Massachusetts, September 3.

This patent is taken for an improvement on the valves of the stove patented by Hastings and Sikes, and the claim is limited to "the mode of constructing the valves used for closing the openings in the bottom and sides of the risers, and at the same time consisting of circular plates with semicircular openings, surrounded by perpendicular rims, to which are attached coverings for the holes in the sides of the risers, and also handles projecting through the slits round the base of said risers, as above described."

It will be seen that the foregoing patent is taken for certain special devices applied to the particular stove above referred to, which was patented on the 23d of November, 1837, and which was noticed in its proper place.

2. For *Connecting Metallic Plates for Boilers, &c.;* Robert Smith, Great Britain, September 3.

This invention consists in "the employment of certain machinery for connecting the plates by compression, that is, compressing the ends of the studs, or rivets, by dies, instead of the ordinary manner of riveting by means of the hammer, and by manual labour." The riveting is to be effected by passing the plates between circular revolving dies, the construction and arrangement of which are represented in the drawings accompanying the patent, and which appear to be well calculated to accomplish the purpose intended. The patentee says that "boilers and other vessels, the plates of which have been connected by the means described, are much more firmly united, and consequently much more capable of resistance, than those which have been riveted in the ordinary manner by hand, and that the rivets so produced have a much more finished appearance and regularity of form than can be obtained by the ordinary strokes of the hammer, whilst the saving of time consumed in the operation is as ten to one." The claim is to "the manner of connecting metallic plates for the construction of boilers, and other purposes, by riveting them together by compression obtained by the aid of machinery constructed on the principles shown in the accompanying drawing, whatever variation in form or dimensions it may receive."

3. For a machine for *Sawing Staves;* Hart Pepper, Southworth, Hampden county, Massachusetts, September 3.

This stave-sawing machine operates by means of two revolving saws, each in the shape of a half barrel; and which saws are to cut from each end of a piece of plank, towards its middle. This mode of sawing is not new, and the novelty in the machine before us consists in the manner of fixing and actuating the two saws. The shaft upon which the saws are respectively affixed, and with which they revolve, is placed upon the end of an arm, or lever, the length of which is equal to the radius of the curve to be given to the staves lengthwise, and these arms are guided in simultaneously, whilst the saws, also, are made to revole, and cut the stave.

Claim. "I do not claim as my invention the form of the saws employed

in this machine; nor do I claim the sawing of staves from each end towards the middle; but what I do claim as my invention, is the giving to each of the saws a curvilinear, reciprocating motion, in the manner, and for the purpose, herein described."

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4. For a *Water Wheel;* William C. Bishop, Ovid, Seneca county, New York, September 5.

This wheel is called the Direct Inclined-Plane Reaction Water wheel; and the principal feature by which it is distinguished from other reaction water wheels, is its complexity. The buckets are in two tiers, placed between a middle and two outside plates; and there is no doubt novelty enough in the arrangement to justify the grant of a patent, and this is all that we feel warranted to say in favour of the invention. The claim is to "the arrangement of the upper, middle, and lower plates, with direct action buckets between the middle and upper plates, with the inclined-plane and reaction buckets between the middle and lower plates, as described."

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5. For a *Printing Press;* William Schnebley and Thomas Schnebley, Hagerstown, Washington county, Maryland, September 7.

The specification of this patent is of great length, with numerous references to the drawings which accompany it. The impression is made by a platten, raised and lowered by a toggle joint, and some idea may be formed of the parts deemed new by the inventors, from their claims, which are the following:—

"1st. The combination of two grooves on the cylinder for the purpose of giving the impression, and operating the carriage and inking rollers, as described. 2d. The arrangement of the ribs and bed by which the bed with the form of type can be removed for correction, and when replaced is stationary for the action of the platten, as described. 3d. The method of taking the papers from the frisket and discharging the same by means of the fingers attached to the platten, as described. 4th. The mode of discharging the papers after being impressed, below the feeding board, by the arrangement of the cords and weights attached to the frisket, as described. 5th. Supporting the frisket on springs attached to the carriage, in the manner described, and, in combination therewith, the springs attached to the platten forcing down the frisket, as described."

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6. For *Spooling Wool*; Zechariah Allen, Providence, Rhode Island, September 13.

This patent is obtained for "an improvement in that part of the process of manufacturing wool, which relates to the spooling of the filaments of rovings which are produced by the carding engines called *breakers*, and are used to supply the feed rollers of the carding engines termed *finishers*."

"This improvement is carried into effect by means of a spooling machine constructed for transferring the rovings of wool from the short spools on which they are wound by the breaker carding engines, to a single long spool, wherein a sufficient number of these rovings are combined from a continuous sheet, or lap, of a breadth adapted to that of the finisher carding engines, to which they are applied for the purpose of supplying them with the wool to be carded."

The claim is to "the arrangement of the spools and arbors or rollers, in combination with the cylindrical drum which sustains and gives motion to

the long spool; and the surface of which moves with equal velocity with the surface of the arbor, or rollers, all as described."

7. For a *Revolving Harrow;* Moses G. Cass, Utica, Oneida county, New York, September 10.

This harrow consists of four rollers revolving on gudgeons, the rollers being set with harrow teeth, and so placed as to constitute a square. The frame in which they run consists of two pieces of timber halved together at their middles, so as to form a cross, into the ends of which the gudgeons of the rollers are received. The harrow is to be drawn by one of the ends of the cross, so that each roller stands at an angle of 45° with the line of draught. The claim is to "the addition of two revolving bars, armed with harrow teeth, placed behind the two already in use, thereby forming a four-sided figure, in the manner described."

8. For *Regulating Motion in Machinery;* Frederick S. Bernard, city of New York, September 10.

This is a device for increasing the friction to any desired extent on the driving parts of such machinery as is to be propelled by the friction of the periphery of one wheel against another, instead of by cog gearing. There are no doubt certain parts of machinery to which the contrivance made the subject of this patent may be applied, but it is not calculated for general use as a substitute for cog gearing. It will be readily seen that if a gudgeon, or shaft, be made to revolve by the pressure of, or between, three friction rollers, and one of these has its bearing upon the shaft increased, the driving power, from adhesion, will be augmented.

Claim. "I do not claim as my invention the substitution of the friction of the surfaces of revolving bodies as a substitute for cog gearing, as this, I am aware, has long been known, but not employed in a manner similar to mine. I therefore claim as my invention the combination of the ring, wheels, and spindle, arranged as herein described, as a substitute for cog gearing, and also claim the method of increasing the pressure against the surfaces of the spindle, wheels, and inner periphery of the ring, by shifting the position of one of the wheels, in the manner described."

9. For *Cutting Shingles from Steamed Timber;* Daniel C. M'Millen, John B. Knoll, Thomas S. Henry, and Matthew Knoll, of the State of New York, September 10.

The claims under this patent are to the special manner in which the respective parts are arranged, which appears to be well calculated to produce the intended effect. We cannot, however, attempt to describe these parts.

10. For a *Double Mould Board Plough*; Ambrose W. Barnably, Ithaca, Tompkins county, New York, September 11.

The claims are to "the mode of changing a double mould board plough to serve either as a right or left handed one for hill side, and other, purposes, by shifting the beam and securing it on the cross piece, as described. Secondly, the attaching the coulter to the upright standard, or cutting edge of the mould board, by means of a clasp and stay, instead of to the beam, as set forth." The many ploughs of a similar kind which have been devised, leave but little chance for any great improvement, and, in fact, the differ-

ence in many of them is not substantial, but consists in mere alterations in the manner of shifting and fastening the beam, &c.

11. For *Metallic Covering for the Roofs of Houses;* Peter Naylor, city of New York, September 11.

Bars of metal are to be attached to the rafters, and these bars are to be so bent as to form a succession of arches, or elevated ridges, to which metallic plates are to be riveted, in a particular manner. Thin bars of metal, placed edgewise, are to extend along these ridges, and the plates of metal used must be of sufficient width to extend from one of these thin strips to another, and so as to lap over, and to be riveted through them.

The claim in "the plan of constructing a metallic covering for roofs, is the manner of connecting the edges of the respective sheets together by lapping them upon, and riveting them through the bars of metal, whether placed upon arch pieces as first described, or directly upon the timbers, sheeting, or planking, or raised therefrom by battens, or strips of wood, or in any other way, whilst the construction and use remain substantially the same with those herein made known."

12. For a machine for *Sawing, Cutting, and Jointing Staves;* Sumner King, Suffield, Hartford county, Connecticut, September 11.

This machine is one of that kind which saws, or cuts, the staves lengthwise of the grain of the stuff, there being a revolving wheel of such diameter as to correspond with the curvature of the stave lengthwise. There are, of course, certain novelties in the manner of arranging the respective parts, upon which to found the right to a patent. The following are the claims:—

"1st. The making the saws or cutters project below the plane of the motion of the wheel more at one end than at the other, so as to cut the stave through without feeding the block up to the saw, or saws, or depressing them to the block, in the manner described.

"2d. The method of jointing the staves by means of the two cutters attached to the jointed arms, and governed by the grooves, as described.

"3d. The mode of setting the timber from which the staves are cut, up to the saw, by the combined action of the racks, and the spring catches, worked by the arm, as described."

13. For *Locks for Banks, &c.;* William Stillman, Westerly, Washington county, Rhode Island, September 14.

This lock is so constructed as that the continued action of two keys is required to shoot the bolt back and forth, there being, of course, two keyholes. The keys act upon opposite sides of the bolt. There are, also, to be what the patentee calls stoppers, within the lock, the nature and object of which we shall not take the time to describe, as it would require more space than we think proper to devote to it. The keys are of the ordinary kind, and the invention, we are apprehensive, is not such as to compete with locks previously in use, where special security is required. The claim does not designate the nature of the invention.

14. For apparatus for *Making Known any Deficiency of Water in a Steam Boiler;* William H. Hale, Brooklyn, Kings county, New York, September 14.

This invention is intended for the purpose of sounding an alarm by the escape of steam through a tube, when there is any dangerous deficiency in the quantity of water in a boiler. Said tube leads into a metallic box, containing fusible metal, so arranged as that when the metal melts, the steam in the boiler can escape through an alarm tube. The particular arrangement made for this purpose forms the subject matter of the claim.

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15. For improvements in the *Odometer*; Smith Beers, Waterbury, New Haven county, Connecticut, September 14.

Odometers have been made, tried, and abandoned, many times, during more than a century; not because they have failed in indicating the distance traveled, but because they have been more objects of curiosity than of actual utility. We have seen some in use, but many more that had been used, and thrown by, sometimes because they were out of order, but more generally because they were no longer things of curiosity. The odometer before us will, no doubt, operate well, but the improver has probably learnt already, that his prospect of remuneration for his trouble and outlay, is but small. The claims, without an engraving, would not make known the peculiarities of arrangement in the present instrument.

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16. For setting and arranging *Sugar Kettles;* Maunsel White, city of New Orleans, September 17.

The claim under this patent is to "the carrying the flues from a single fire in two semicircular arches, under two sets of sugar kettles, arranged in a circle, for the purpose, and substantially in the manner described."

By this mode of arrangement, the patentee says, "a great saving of fuel is effected, room is economised, the operations are performed with greater facility and convenience than heretofore, and other advantages are attained." All of which appears probable, judging from the description and drawings.

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17. For an improved *Tooth Extractor;* John M'Connell, city of Philadelphia, September 20.

This patent is taken for an improvement on the Dutch key. "In this instrument, as ordinarily made, the hook, or claw, turns upon a joint pin above the bolster, or that part which forms the fulcrum of the instrument in the act of drawing a tooth. In my improved instrument, the hook, or claw, I sometimes make so as to turn upon a joint pin, as heretofore, for the purpose of placing it upon the tooth; but when so placed, it is to be prevented from turning upon its joint pin by means of a check lever, or spring latch, which is made to fall into a notch formed in the head of the hook for that purpose; and when so fixed, the instrument may be turned in either direction without loosening the hook, or claw, so that the latter may become the fulcrum upon which the instrument may turn in the operation of extracting a tooth; but instead of allowing the hook, or claw, to turn upon a joint pin, I sometimes make it with a shank which passes through a mortise in the head of the bolster, where it is acted upon by a pinion by which its claw end is drawn firmly against the tooth, when it is fixed in its place by means of a tightening screw, thus enabling a single claw to fit every tooth, whatever may be its size.

"I will here remark, that instead of the movable bits, with their points,

such points may be formed directly upon the bolster, but they will soon lose their sharpness, and will, therefore, be inferior to the movable bits.

"What I claim as my invention in the above described instrument, is the manner of confining the hook, or claw, in its place, by means of the spring latch, or lever, as described in the first modification of my improved instrument. I claim, likewise, the manner of constructing and operating the claw so that a single claw may serve for teeth of every size, by causing the shank of the claw to slide through a mortise in the head of the bolster, and be regulated and affixed by the rack and pinion, and the tightening screw, substantially as herein shown. I also, claim, in combination with the foregoing, the insertion of movable bits, furnished with points, on the sides of the bolster, in the manner, and for the purpose, herein set forth."

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18. For a machine for *Pressing and Napping Hats;* Andrew Rankin, city of Newark, New Jersey, September 20.

The claim under this patent will give a good general idea of the invention. It is as follows: "What I claim is the operating upon the hat bodies in the process of napping by double friction boards, between which they are placed upon rollers, furnished with suitable cloths lapped around them, as set forth. I also claim the employment of a single friction board in combination with a traversing carriage beneath, in which the rollers play, the bottom of the box operating as a second, or lower, friction board. And I do hereby declare, that I do not intend to limit myself to the precise form or disposition of the respective parts, as set forth, but to vary these as I may think proper, whilst I attain the same ends by means substantially the same."

The rubbing boards, and other apparatus above referred to, are contained in a closed box, into which hot water is to be pumped from a kettle, there being other devices also necessary to the conducting of the process.

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19. For an improved *Revolving Hay Rake;* Ephraim and Moses D. Wells, Morgantown, Monongahela county, Virginia, September 20.

After a very long description of this machine, we arrive at the following brief claim, namely, to "the manner in which we regulate the revolution of the rake by means of the handle, in combination with the catch plate, the cross bar, and the rod, as described."

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20. For an improved *Stove;* Eldridge M'Collum, Weare, Hillsborough county, New Hampshire, September 20.

By this improvement, "the ordinary open, or Franklin, stove, is made convertible into a close cooking stove, and combined with ovens on each side thereof, in such a manner as to combine economy in the use of fuel, with convenience in the application of heat, either for the purpose of cooking, or of heating apartments." The particular manner of directing and governing the flues, and of arranging the other parts, is not a matter for verbal description, we therefore pass it over.

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21. For a machine for *Setting Saws;* Joseph Beach and David Culver, city of Hartford, Connecticut, September 20.

The saw to be set is placed between two bars of iron, and wedged in place, with the teeth projecting over a bead along the lower bar. The set-

ting is to be effected by means of a hammer and punch. The claim is to this arrangement.

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22. For making *Pill, and other, Boxes;* Jacob Bentz, city of New York, September 20.

The subject of this patent is simply a machine for cutting thick shavings from blocks of wood, which shavings are subsequently to be united together by covering them with paper. The claim is to "the plane and stock having a rectiliniar reciprocating motion, with the press for holding the block, in the manner described." It would be very easy to make a machine to answer the purpose, and equally well, in all respects, with that represented, without interfering with the patent, as the machine does not present any thing of special originality.

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23. For a machine for *Setting Elliptic Springs;* George J. Neveil, city of Philadelphia, September 20.

This machine is for setting the plates of elliptic springs to the proper curvature; this setting is effected upon a bed of cast, or of wrought, iron, the upper surface of which has the ordinary curvature to be given to the spring, but for the purpose of increasing the curvature, the bed is divided into two parts by a cross section at its middle, and by raising this part whilst the ends are kept down, the set of the spring will be increased. The setting is effected by means of two rollers, which are attached to arms of the proper length, and working on joints below the bed, which arms may be raised or lowered when required. The steel to be bent is heated, laid upon the bed, and held down, when the rollers are to be passed over its surface.

The claim is to "the combination of the two beds, or forms, regulated as described, with the rollers attached to the levers, and governed by a lever and springs, for the purpose and in the manner set forth."

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24. For an improved *Sled, or Sleigh;* Daniel Carpenter, Nelson, Madison county, New York, September 20.

The object in view, in the contrivance which is the subject of this patent, is to enable the horse to hold back against the descent of a sled, or sleigh, in going down hill. The patentee states that the nature of his invention "consists in applying the power used to draw the sleigh directly at the bottom of the runners, or as near the place of friction, or resistance, as possible, and the power used in holding a sleigh back in going down hill over the sleigh, or in such a manner as that the tongue, or pole, used in holding back, shall incline to push down instead of up, in the act of holding back." The claim is to the combination of the pole, or perch, connected with the drawing apparatus, or lower part of the sleigh, with the one attached to the apparatus for holding back on the upper part of the sleigh, for the purpose, and in the manner described.

There are two poles, one proceeding from the lower, and the other from the upper, part of the sleigh carriage, one of them standing above the other, and these poles are loosely connected together at their outer ends, in such manner as that the change in the position of the sleigh will change the resistance, in holding back, from one of them to the other.

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25. For a machine for *Making Rivets;* Francis A. Cannon, city of Boston, Massachusetts, September 25.

This rivet machine has much novelty in the manner in which its respective parts are arranged, but we shall not now describe it, as, although not complex, it would still require the illustration of a drawing. The claim refers by letters to the individual parts.

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26. For improvements in the *Machine for Manufacturing Paper*; William Knight, Abijah L. Knight, and Edward F. Condit, Whippany, Morris county, New Jersey, September 25.

"In this machine, the paper is formed upon a revolving cylinder, the construction of which is similar to that of the cylinder now in use, but it is made considerably larger in diameter than those generally employed, and the paper stuff, or pulp, is applied to it in a manner different from that used in the other cylinder machines." The pulp is supplied from a pulp box, above the cylinder, and is fed to it through a gate, properly regulated. It is led off from the first cylinder, and passed between pressing rollers; and from these conducted around and between a succession of drying cylinders, usually ten in number, placed in pairs one above the other, so as to operate as pressing, as well as drying, cylinders. There are many points of arrangement which we pass over, and furnish the claims made, which are as follow:

"We claim the combination of the revolving bands with the cylinder for giving an even edge to the paper at each end of the cylinder, causing, by said arrangement, the said band to revolve by the cylinder itself.

"We claim the running of the paper cylinder upon an independent frame, resting upon rollers on a stationary frame, in such manner as to admit of a vibratory motion being communicated to said upper frame, and the parts appended thereto, as described.

"We claim the combining of the naked wooden roller, with the roller, for the purpose of collecting the broken paper, or pulp, as set forth.

"We claim the arrangement of the drying cylinders in a number of successive pairs, for the purpose of simultaneously drying and pressing the paper, as described."

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27. For a machine for *Cutting Round Tenons;* Charles Whitsitt, Connersville, Fayette county, Indiana, September 25.

This machine consists of a cutter with saw teeth, formed like a trephine, or trepanning instrument. This is to be guided by a centre pin, which is forced forward by a spiral spring, but which recedes into a socket, as the saw advances. The claim is to "the combination of the rotary saw with the centre pin, pressed out by a spring, as described."

This is rather an imperfect affair, as there is not any provision whatever for cutting away the stuff surrounding the "round tenon," so as to form a shoulder, and fit it for any purpose.

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28. For a machine for *Crimping Boots*; Horace Ferre, Springfield, Hampden county, Massachusetts, September 25.

There is not much novelty in this contrivance, but still it may be a real improvement. The patentee says, respecting it, that he does not claim the mode described of crimping leather, as this was patented by E. G. Pomeroy, on the 4th of October, 1836, but claims as his invention, the mode of attaching the leather to the plate, by combining with said plate, a plate, nut, and perforated screw, through which the straining screw passes.

29. For a *Steam Boiler*; Richard V. De Witt, city of Albany, New York, September 25.

"*Claim.* I do not claim, as my invention, the placing of a furnace, or of flues, within a boiler, nor do I claim the giving to the flues a scroll like, or spiral form, this having been done in the labyrinth boiler; but I limit my claim to the continuous diminution of the capacity of such a flue, for the purpose, and in the manner set forth, however the furnace may be situated, and whether the combustion be kept up by the ordinary draught, or urged by a fan wheel, or other blowing apparatus."

The boiler upon which this is an improvement, was patented by Mr. Van Order, of Ithaca, New York; his flue was scroll formed, but its section was the same throughout, the sides of the scroll having been parallel to each other. Mr. De Witt says: "but instead of keeping the sides thereof parallel longitudinally, I cause them to approach each other from the point at which the flue leaves the furnace until it terminates in the chimney, so that the space for the gaseous products of combustion undergoes a regular diminution. The object of this gradual contraction of the flue is to compress these products, as the gases contract by their loss of heat, by which contraction said gases are more effectually brought into contact with the walls of the flue than in the labyrinth boiler."

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30. For an improvement in *Mill Spindles;* Joseph C. Gentry, Dayton, Montgomery county, Ohio, September 25.

The mill spindle referred to is of the kind used in portable grist mills, which have stones of small diameter, usually of from twenty inches to two feet; and the improvements are in the manner of constructing the driver, and the oil box for the step of the spindle. The claim is to "the placing of the driver, or balance rine within a notch or opening in the upper end of the spindle, its lower end bearing on a fixed point, whilst its upper end is sustained by a point which is free to play to a small distance in the cap, as set forth. Also, the manner of forming the spindle step and oil box by means of the screw nut, washer, and cap, connected and combined with the step, and operating substantially in the manner described."

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31. For a *Road Leveling Machine:* John Scholder, Canton, Stark county, Ohio, September 25.

A scoop, or scraper, which is in form a concave semi-cylinder, is hung at its ends by two gudgeons to a frame, running upon wheels. The gudgeons are not in the centre of curvature of the semi-cylinder, but are near to its periphery, so that when the semi-cylinder is made to move round on the gudgeons, by means of handles affixed to it for that purpose, its cutting edge will be thereby raised or lowered. This semi-cylinder is intended to operate in a way similar to that of the ordinary scraper. The carriage runs upon wheels, and has a tongue by which it is to be drawn forward. The claim is to the combination of the scoop attached to the frame, with the runners and lever frame, for the purpose of regulating the scoop, in the manner described."

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32. For *Squaring and Finishing the Heads of Bolts, Nuts,* &c.; John Bellemere, city of Philadelphia, September 25.

A chuck for a lathe is so constructed as that a number of screw bolts and nuts may be fixed in it, in such a manner as that by means of a slide rest one

side of each bolt, or nut, may be turned and finished. The mode of doing this, when once the idea is conveyed, will readily occur to any handy workman.

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33. For an improvement in the construction of *Lime Kilns*; A. H. Tyson, city of Baltimore, September 28.

Claim. "What I claim as my invention is the introduction of a vertical pipe in the centre of the kiln for increasing the draught. Also, the introduction of water to prevent the vitrification of the lime, by means of pipes, arranged as set forth. The constructing of the centre grate of the form described, so as to permit the ashes and refuse lime to slide down its sides and pass between the grate bars into the ash pit below. Also, the employment of the inclined doors for the discharging the lime."

The vertical pipe is suspended in the centre of the kiln, and is perforated with numerous holes at its sides, so that air passing into its open, upper end, may be diffused through the lime. This tube, as represented, rises to a small distance, only, above the kiln, and must, therefore, be in an atmosphere of carbonic acid, which would aid but little in promoting combustion.

Through the sides of the kiln there are a number of tubes inserted, which are furnished with stoppers, and through these tubes water is occasionally to be poured, which, it is said, will reduce any vitrified lime to powder, and cause it to fall down, and pass through the grate into the ash pit.

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34. For *Buoying up Ships, or Vessels:* John Brown, Stonington, Connecticut, September 28.

Along each side of the vessel to be buoyed up, there are to be placed eyes, or staples, to which rows of platforms extending out horizontally from each side of the vessel, at the water line, are to be securely fastened. Air-tight bags are passed along on each side of the vessel, under the platforms, or brackets, and when these bags are inflated by pumping air into them, the vessel will be buoyed up. The claim is to "the means and manner of securing the bags, or buoys, under the vessel, by means of the brackets, and other fixtures, as set forth."

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35. For improvements in *Pen Holders:* William Fife, city of Philadelphia, September 28.

This pen holder has an awkward appearance when first seen, but it is pleasant in use, affording much advantage in the management of the steel pen. The part which clasps the pen, and which is affixed to the end of the handle, is attached thereto by a slide which is a segment of a circle, of which the point of the pen is the centre, and whatever lateral slope may be given to the pen, its point does not change its place. The slit, as held, always corresponds with the downward stroke of the pen. The handle is not round, as in the common pen holder, but is made in such form as that where the thumb and middle finger press it in the act of writing, it is nearly flat, and considerably broader than the ordinary handle, and it is otherwise so formed as to be adapted to the fingers, and to take the proper position between them.

The claim made is to "the employment of a segmental piece, in the manner set forth, by means of which the obliquity of the slit may be easily varied in any required degree, whilst the point of the pen will not be thereby

removed from its coincidence with the axis of the handle, or with the centre of the circle of which said curved piece is a segment."

36. For a combined *Lifting and Forcing Pump:* Abraham Mixsell, Belvidere, Warren county, New Jersey; assigned to Peter T. and Daniel D. Campbell, Oxford, New Jersey, September 28.

There are some peculiarities in the construction of this pump, but without the drawings it would require too much space to make them known. The claim is to the particular manner in which the parts are arranged and combined, said parts being referred to by letters.

37. For a *Cocoon Lodgment:* Solomon M. Jenkins, Easton, Talbot county, Maryland, September 28.

The claim made is to a "double frame, the lowermost of which is divided into spaces by means of slats, and twine, or other suitable material, with pins descending from said slats, constructed as set forth." The arrangement of this apparatus appears to be such as to adapt it well to the convenient spinning by the silk worm, and the ready removal of the cocoons.

38. For an improved mode of *Tilting Cars and Wagons:* Jason C. Osgood, Chittenango, Madison county, New York, September 28.

The claim is to the employment of a traveling roller, so constructed as to catch upon the tilting hooks, and retained by the guides attached to the cross bars, in combination with the body and car, or wagon, frame, as described.

39. For a *Press for Cotton, and other Articles:* James R. Hitchcock, and William F. Sewell, city of New York, September 30.

The description of this press extends through nine pages of record, with references to thirteen different figures in the drawings. The claims, also, refer, throughout, to these drawings, and we are compelled, therefore, to dismiss this matter without an attempt at description, which we must fail in making clear.

40. For *Double Seaming Tin Plate*; Hiram Van Pelt, and Benjamin Armstrong, city of Troy, New York, September 30.

The object of this invention is to double seam the bottoms, or heads, of cylindrical vessels, which is effected by means of rollers operating in the manner of those now in use for seaming such work. To fit them for this purpose, the rollers are so changed in form as to effect the double seaming, and the patentees say that they "do not claim the groove described, on the upper roller, that having been in use; but we claim the inclined plane surface, taken in its crosswise direction, extending round the said upper roller, as described, and substituted for said groove, in order that as the double seam is finished by the pressure of the lower roller thereupon, its greatest pressure shall be at its outer edge."

41. For an improvement in *Force Pumps*; Thomas W. H. Moseley, Paris, Bourbon county, Kentucky, September 30.

In this pump, when placed in a well, the chamber and valves are to be entirely under water; and there are two rods which extend down from the brake, and are attached to the opposite ends of a vibrating lever with equal

arms, to one end of which lever the piston rod is also attached. The two rods are jointed to the brake at equal distance from its fulcra. By this arrangement, the rods extending down from the brake operate upon the lower lever by tension, and may therefore be small. There is also a device for letting the water out of the ascending main, to prevent its freezing. The claim is to "the manner in which the rods, operating by tension, are combined and arranged with the lever, the brake, and the piston rod, so as to actuate a force pump, situated entirely below the surface of the water in a well or other reservoir; the parts being so arranged in other respects, in the manner set forth, as effectually to prevent the freezing of the water."

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42. For a *Cooking Stove*; Noble Peck, Carmel, Putnam county, N. York, September 30.

Any new cooking stove must, to a certain extent, nearly resemble many others, and we need not say, therefore, that such is the case in the present instance. What is supposed to be new is of course contained in the claim, which relates entirely to the manner of arranging the parts connected with the hearth and ash pit.

"The invention claimed consists in constructing the vertical part, or front plate of the ash pit, with openings for admitting air, regulated by a grated valve, in combination with the grated hearth over the sunken hearth, so that coals on the back of the hearth may be brought to the front, and a gridiron placed thereon for broiling without the coals being extinguished, as a draught of air will pass through the front of the ash pit to the coals, and thus continue the combustion."

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43. For *Preventing Steam Boiler Explosions*; Isaac N. Coffin, city of Washington, September 30.

"The nature of my invention consists in the so adapting of a float within the boiler to a valve, escape tube, rotary engine, and pumps, as that by the lowering of the water in the boiler, and the consequent depression of the float, a portion of the steam shall escape, and in so doing, shall give motion to the rotary engine, and through this to a pump, or pumps, for supplying the boiler with water." The claim is to this arrangement.

We believe that few, if any, practical engineers would deem an engine boiler secure from explosion, where the action of a float within the boiler was intended to produce the effects thus anticipated from it.

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44. For an improvement in the *Wheat Fan*; Alfred Edwin, Jefferson, Frederick county, Maryland, September 30.

There have been many patents taken for improvements on the wheat fan, or fanning mill, most of which are for trifling changes in the manner of arranging certain parts of it, without essentially altering its construction in any one point, and indeed it does not seem to require this. In the present case, the claim is to the "having openings in the sides of the fan case for the screen to extend through, and vibrate horizontally therein, and in attaching to the bottom or shoe of the hopper an additional board, extending horizontally over the whole length of the screen, to be used when cheat is to be separated from grain."

Specification of a patent granted to George Nelson, *of the county of Warwick, for his invention of a certain new or improved process or processes, by the use of which the qualities of a certain gelatinous substance or gelatinous substances, called isinglass, may be improved.*—[Sealed 22d May, 1837.]

The gelatinous substances employed, according to this invention, are the impure and inferior sorts of isinglass, commonly known by the names of honeycomb pipe or tongue block, lump samony book, and samony leaf. These substances are more impure and much less soluble than the best sort of isinglass, imported into this country under the name of Russian leaf and staple, which is in itself, as imported, so pure as not to require any further operation.

The impurities contained in the first-mentioned articles are bits of skin and flesh and other extraneous matters, which are not easily dissolved. The substances to be employed should be cut into thin pieces, if necessary, and subjected to the process of maceration for twenty-four hours, if the substances are thin; but, if in lumps of any considerable thickness, they may be left in the macerating vessels for from two to six or eight days, according to circumstances. In this process they are subjected to the action of a solution of caustic alkali, consisting of two parts of potass or three parts of American pearlash, one part of freshly-burnt lime, and thirty parts of water.

It is easy to determine when the matters have become sufficiently macerated, by means of a fork or other suitable instrument. When this is correctly ascertained, the gelatinous substances should be removed in wooden trays or sieves, and piled one on the other in a suitable vessel, for the purpose of being washed;—this vessel is furnished with supply and waste pipes, the former of which allows water to flow into the top part of the vessel, and the latter draws it off.

The washing operation should be continued for two or three days, or until all the alkali is entirely removed. The gelatinous substances are then to be placed in a close closet, of the ordinary construction, and subjected to the action of sulphurous acid gas, obtained from the combustion of sulphur, within the closet. After this operation has been continued for a sufficient length of time, the gelatinous substances must be again washed to remove the sulphur, after which they should be dried by a draft of cool dry air,—the temperature of sixty or sixty-five degrees of Fahrenheit is preferred for this operation; the isinglass thereby produced and purified is then fit for use.

The patentee does not claim, as his invention, any of the processes or operations above described, as applied to gelatinous substances in general, but confines himself to the application of caustic alkali to the several gelatinous substances, called isinglass, that are mentioned in the commencement of the specification, that is to say:—the inferior or impure descriptions, known by the names of honeycomb pipe or tongue block, or lump samony book, and samony leaf, for the purpose of rendering the same more pure, more soluble, and more generally useful, than they are in the state in

which they are imported into this country. It being already observed that the superior isinglass, as for instance, the best Russian leaf and staple, possesses these qualities without the aid of this invention.

Lond. Jour. Arts & Sci.

Specification of a patent granted to JOHN WOOLRICH, *of Birmingham, in the county of Warwick, for an improved process for manufacturing carbonate of lead, commonly called white lead.*—[Sealed 11th October, 1838.

This invention appears to be an improvement upon Torrassa,—Muston and Wood's patent for making white lead. In the latter, white lead is produced by the friction of small pieces of lead rubbing against each other in a vibrating or rotary frame. The oxide thus produced is turned into a carbonate by the action of the atmosphere. It will, therefore, be perceived that white lead is produced mechanically, and not by the aid of acid solutions.

The present invention is for producing oxide of lead by mechanical means, with the assistance of certain acid solutions, and the product being acted upon by carbonic acid gas, becomes carbonate of lead.

The patentee describes his process in the following manner:—The ordinary lead of commerce is divided into small pieces, about the size of shot or grains of barley, in any convenient manner, such as by melting it and running through a metallic sieve into water. A quantity of lead, so reduced, is placed in a cylindrical or hexagonal vessel, made of lead or earthenware, having a hole in the centre of each end, about one-sixth the diameter of the vessel. The small pieces of lead in the vessel are then moistened with the following acid solution, viz.—protoxide of lead, dissolved in dilute ascetic acid, in such proportions as completely to neutralize the acid, and cause the solution to be of the specific gravity of 1.60. The apparatus being thus prepared, and the cylindrical or hexagonal vessel being mounted in a horizontal position; rotary motion is given to the said vessel, and the lead therein contained is kept continually moistened with the solution.

The rotary motion given to the vessel keeps up a continual friction amongst the pieces of lead, and which, assisted by the solution, causes very minute particles to be detached therefrom, and form a product which may be easily removed by washing. The product thus obtained is removed every twelve hours, and fresh quantities of lead, moistened in the manner above mentioned, are added, so as to keep up the original quantity in the vessel.—This product, and the fluid used in washing the same from the rotary vessel, are placed in another vessel, closed and kept constantly stirred by a spindle, which is moved round in the vessel. A stream of carbonic acid gas, obtained from a charcoal fire, is passed through the vessel, and the result will be carbonate of lead, or white lead, suspended in a liquid.

The lead is easily separated from the liquid by allowing it to settle for a few hours, when the carbonate, by its own gravity, will sink to the bottom, when the supernatant liquid may be drawn off by a syphon, or the carbonate of lead may be separated by filtration. It is then dried, when it will be fit for use.

The patentee here observes, that other solutions may be used, if preferred, viz.—a solution of protoxide of lead, dissolved in dilute nitric acid; or a solution of acetate of lead, in water; or a solution of carbonate of

potash, or carbonate of soda, in water; or a solution of nitrate of lead in water; dilute solutions of ascetic acid, or nitric acid, may also be used without being previously combined with protoxide of lead.

The hexagonal vessel should be about five feet long and twenty inches in diameter, with a round hole of from three to four inches in diameter, exactly in the centre of the ends thereof. About eight or ten hundred weight of lead, prepared as aforesaid, is a sufficient charge.

The patentee claims the use of all the solutions named, in combination with metallic lead; but he does not claim, as his invention, the mode of reducing the ordinary lead of commerce to pieces of such size as will render it available to the objects of the invention; nor does he claim the mode of obtaining carbonic acid gas from charcoal, as aforesaid; but he claims, as his invention, "the forming, from the friction of the ordinary lead of commerce, moistened with any such solutions as hereinbefore mentioned, a product which may be converted into carbonate of lead, or white lead, by passing carbonic acid gas through such product, and then separating and drying the product so obtained, which is thereby converted into carbonate of lead, or white lead." Ibid.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the comparative advantages of Long and Short Strokes in Steam Engines.

In our last volume, some discussion took place upon the advantage of long and short strokes in steam engines, without any satisfactory conclusion being arrived at. We have now the pleasure of extracting the following excellent paper illustrative of this subject from a very able pamphlet by Mr. John Seward, C. E., (printed for private circulation only) in which this question is treated in all its bearings, with consummate skill and practical acumen. We shall have the gratification of drawing further upon this source in subsequent numbers, meanwhile we commend the present extract to the careful perusal of our readers:—

A popular notion has for a considerable time past prevailed, that a long stroke engine is much superior to a short stroke engine; and it will consequently be found that the practice of most, if not all, engineers, is greatly regulated by this idea. On very careful consideration, however, it does not appear that this alleged superiority can be satisfactorily proved. That a long stroke engine, under certain circumstances, may be much more advantageously employed than a short one, is undoubtedly true, but considering the steam engine *per se*, that is, without reference to adventitious or extraneous circumstances, it would be difficult to show that the former has any advantage whatever over the latter.

For let a careful comparison be made of a long stroke engine with a short stroke engine; let there be two beam engines of thirty horses power each, both equally well made, but the one having a stroke of eight feet, while the stroke of the other is only four feet, the cylinder of the latter being double the area of that of the former; it being understood that both engines shall make the *same* number of revolutions per minute; the steam passages and valves to be of the same area and capacity; and the two engines in all other respects to be well proportioned and made without any limitation as to space or weight.

Now as regards the mere mechanical effect of the moving power, (*i. e.* of the steam) it is perfectly clear that it must be precisely the same in both

engines, because the same volume of steam must produce the same mechanical effect, whether it is let into a long narrow cylinder or into a short wide one; therefore, if there be found any difference in the efficient duty or economical working of these two engines, that difference must arise from circumstances quite unconnected with the mechanical effect of the steam power.

The only circumstances which really can make any essential difference in the efficient duty or economical working of these two engines are these —First, the greater or smaller quantity of friction in the various parts of the machines. Second, the greater or lesser radiation of heat from the cylinders and passages; third, the greater or smaller loss of steam by the clearance of the piston at the top and bottom of the cylinder. Fourth, the *inertia* and the impulse of the parts of the machine in motion on the surrounding air.

First, then, of the *friction*. It will be found in the working of a well made engine of the proportions of the short stroke engine under comparison, that more than four-fifths of the whole friction are due to the packings of the piston and air pump bucket, and of the piston rod and bucket rod,* and less than one-fifth to the main gudgeons, the end gudgeons, the crank pin, and other moving joints about the engine. But the friction of the piston packing will vary as the circumference of the piston, multiplied into the distance which the piston travels. Now in the long stroke engine, the piston, supposing it to be 30 inches diameter, will move eight feet, and the friction of the packing be therefore as 24, while in the short stroke engine the piston will be about 42.4 inches diameter, will move only four feet, while the friction of the packing will be only as 17. In the same way, it can be shown that the friction caused by the packing of the air-pump bucket, of the piston rod, and of the bucket rod, is also respectively in the ratio of 24 to 17 in the two engines. With respect again to the friction due to the main and end gudgeons, &c., it is clear that it will be less in the long stroke engine, because in the latter engine, the force acting upon these parts will be one-half what it is in the short stroke engine. Assuming, therefore, 100 to be the whole quantity of friction in an ordinary engine, then 80 of these parts in the short stroke engine will be due to the piston, air-pump, bucket, &c., while in the long stroke engines the friction of these parts will be as 113, that is $= \frac{24}{17} \times 80$, but the friction on the main and end gudgeons in the former engines will be as 20, and in the latter only 10, making the total friction in the short stroke engine 100, and in the long stroke engines 123, or one-fourth more.

Second. The *radiation of heat* will be in proportion to the extent of the surface, but the surface of the long stroke cylinder is much greater than that of the short cylinder, whence it follows that the loss by radiation in the former, must be greater than in the latter.

Third. The *clearance of the piston* at the top and bottom of the cylinder, which will evidently be greater in the short stroke engine than in the long stroke engine. Because the area of piston in the former is double that of the latter, some persons would be disposed to say that the loss by clearance in the former must be double what it is in the latter. But this is not quite certain, for it is not required to give so much clearance in a 4 feet stroke cylinder as it would be advisable to give in an 8 feet stroke cylinder, the

* The friction of the slide is not included, as that will obviously be the same in both engines.

reason of which is obviously that the spring and elasticity of the parts in the long stroke engine must be much greater than in the short stroke engine, and that they must therefore require more clearance. However, it is probable that there would be more lost in the latter engine than in the former.

The loss of steam by filling the passages and nozzles, as also by the radiation of heat from those parts, must evidently be the same in both engines.

Fourth. *The inertia and impulse of the moving parts on the surrounding air.* The loss in a steam engine occasioned by these two causes may not be very considerable; indeed as regards what is called the *inertia* of matter in the moving parts, it is doubtful whether any such source of loss really exists; however if it does exist, it is clear that the amount of loss must vary in proportion to the *momenta* of those parts of the machine which are in motion, but as the *momenta* must be as the mass of matter in motion multiplied by the velocity, and as these are evidently much greater in the long stroke than in the short stroke engines, (because the parts in the former are, if anything, of greater weight than in the latter, and also move at a double velocity) it follows that whatever loss may arise from the *inertia* must be much greater (double?) in the long stroke engine than in the short stroke engine. With regard to the loss occasioned by the impulse of the moving parts on the air; it must be admitted that in very slow motions it cannot be very important; nevertheless with a material increase of velocity this source of loss becomes serious; it varies as the extent of surface of the moving parts multiplied into the *square* of the velocity. It is tolerably manifest, however, that the surface of the moving parts in the long stroke engine will be, if any thing, greater than the short stroke engine, and that the velocity of the former will be twice that of the latter; therefore, the loss by impulse on the air in the long stroke engine must be four times that in the short stroke engine.

Beside the foregoing causes, it is doubtful whether there are any others that can produce any material difference in the efficient duty or economical working of a steam engine, at least none that can in any way influence the question now under consideration. In estimating, therefore, the advantages of the short and long stroke engines, we have in favour of the former a diminution of loss occasioned by friction, by radiation, by *inertia*, and by impulse on the air; while on the other hand, we have in favour of the long stroke engines, a diminution of loss in the clearance of the piston at the top and bottom of the cylinder. It may be difficult to strike an exact balance between these several sources of loss; but there can be no doubt that in a steam engine the loss by friction is much greater than the loss by all the other causes before mentioned put together; and it is past dispute that the balance of loss as regards these causes, is decidedly against the long stroke engine. (The advantages offered by the short stroke engine as regards diminution of space and weight, although of vast importance, are not here adverted to, because they form no part of the immediate inquiry.)

It may be objected, that to select an engine with an 8 feet stroke, and a cylinder of only $2\frac{1}{2}$ feet diameter for comparison, is not a fair proceeding, because an engine of such proportions is unusual; and it may be also asked whether, if the principle is further extended by making the stroke only 2 feet, and again doubling the area of the piston, whether the advantage would still be in favour of the short stroke engine?

To this it may be answered, that although an engine of 8 feet stroke and $2\frac{1}{2}$ feet diameter of cylinder, may be unusual in this country, it is not so in

America; in that part of the world many engines are employed of very nearly the above proportions, for purposes of steam navigation; and in which engines it is not unusual for the piston to travel at the rate of 300 or 400 feet per minute. Again, as regards the carrying out of the principle by still further reducing the length of stroke, say to two feet, and increasing the diameter of cylinder proportionately, say to five feet; there is no doubt whatever that such an engine would have precisely the same mechanical effect as either of the other two; but the balance of advantages would be against an engine of such proportions, because it would be verging to an extreme on one side, as much as the 8 feet stroke engine may be thought extreme on the other side. It may, however, be safely affirmed that the principle applies most powerfully to the case where the diameter of cylinder is the same as the length of stroke, because in that case the proportions are most favourable for the diminution of friction and of radiation, and offer the minimum of disadvantage under the several heads of loss above enumerated.

As it is manifest, therefore, that in all particulars which more immediately affect the beneficial employment or working of a steam engine, the long stroke has no manifest superiority over the short stroke; it may appear strange that so decided a preference should have hitherto been given to the former by the generality of engineers. Perhaps this is chiefly to be attributed to the circumstance of the long stroke offering, on most occasions, greater convenience than a short stroke. Much may be due also to fashion. The earliest application of steam power was for the purpose of pumping water in the course of mining operations, and in this sort of work a good long stroke was found to be attended with considerable convenience and advantage. In blast engines, and many other of the earlier applications of steam power, the same result was manifest; the earlier habits and ideas of engineers were therefore naturally associated with long stroke engines. Moreover, the earlier manufacturers of steam engines had neither good machinery nor good workmen; they could neither depend upon the correctness of their proportions nor upon the exactness of the workmanship; besides, timber and other inefficient materials were formerly employed to a considerable extent in the construction of engines; from all which causes, imperfections and irregularities were numerous in the earlier engines, and they were consequently very inefficient. As all these sources of imperfection and inefficiency operated much more extensively against short stroke engines than against long, it is no wonder that the latter soon obtained a preference, and that the prejudice should still continue to exist, notwithstanding the same causes are no longer in operation. At the present day, with our good materials and workmanship, exact proportions and adjustments, a short stroke engine will be found to work as accurately and as perfectly as a long stroke engine.

There is one very important circumstance to be kept in view as regards long and short stroke engines; which is, that whenever an engine of the latter description has hitherto been made, it has always been considered necessary to keep the cylinder nearly of the same diameter as in the long stroke engine, and to cause the engine to make a greater number of revolutions in proportion to the shortness of the stroke, so that the piston, in every case, might travel at a nearly uniform speed of about 200 feet per minute. Now, to a short stroke engine, made on this plan, there may undoubtedly be many objections. The more frequent alternation of the stroke—the greater loss of steam by the more frequent filling of the passages and noz-

zles, and the clearance at the top and bottom of the cylinder—the much greater angular motion of all the bearings and moving joints, thereby materially increasing friction and wear—are all circumstances tending to lessen the efficiency of a short stroke engine made upon this plan. It is clear, however, that an engine made upon the principle hereinbefore laid down, is not open to the same objections.

And, as regards the speed of the piston in engines, whatever may be the length of stroke, being regulated to the uniform standard of about 200 feet per minute, there can be no valid reasons given for such rule; no one can prove that double the above speed, or only one-half that speed, might not be employed with equal or greater advantage; it is certain that in many steam engines of the transatlantic world, the pistons move at a speed of 300, 400, and even 500 feet per minute, and no substantial reason can be assigned why such engines should not do good duty; indeed it may be safely affirmed that whether the speed of an engine be 100 feet or 200 feet, or 300 feet per minute, it matters nothing; provided all the parts of the engines are well proportioned for the proposed speed, the efficient duty and economical use of the engine will be much the same, keeping this always in mind, that the *slow speed will be more favourable for the easy and pleasant working of the engine, and for durability.*

This question may, however, be asked—Since it is shown that the long stroke has no superiority over a short stroke, but, on the contrary, that the balance of advantage is rather in favour of the latter, is it intended to recommend the invariable adoption of a short stroke engine, to the total exclusion of a long stroke? By no means. All that is contended for is, that in every case a length of stroke should be adopted, whether long or short, that shall prove to be most convenient, and best adapted to the object for which the engines are to be employed; and that an engineer should not be fettered and cramped by any fallacious abstract notions, that what is termed a long stroke engine must necessarily be more efficient than an engine with a short stroke; and that he should not therefore be obliged to sacrifice many other far more important considerations for the sake of obtaining, in every case, the longest possible stroke.

The application of steam power for the purpose of navigation has had such wonderful results, the character of the steam engine has become so greatly changed, and the proportions so altered, that a marine engine of the present day, and a land engine of former times, can scarcely be recognised as belonging to the same class of machines. The length of stroke of marine engines is probably not more than half what used formerly to be given to engines of similar power for mining and manufacturing purposes, but still no one can say that this departure from old rules and maxims has been attended with any disadvantage; on the contrary, it can be shown to have been most beneficial and glorious in its results; and if a still further departure from old established notions can be proved advantageous for steam navigation, we have no reason whatever to regret the change.

There is no question that the ordinary beam engine as employed in steam vessels, has proved most efficient, and that in its application it has been productive of vast benefit. If, however, by a modification of the existing steam engines, these benefits can be still further augmented, and that in an eminent degree, no consideration ought to stand in the way of the proposed improvements. The great and paramount objects to be aimed at in the construction of steam engines for navigation are the following, viz. the greatest saving of fuel, the greatest saving of space, the greatest saving of weight,

and the greatest durability of the machinery. The more eminently the marine engine shall combine the above important qualities, the more nearly will it have arrived at perfection; and much as may be advanced in favour of the beam engines generally used for marine purposes, it cannot be considered presumptuous to declare that the system of engines employed in the *Cyclops* and *Gorgon* frigates, is far superior in all the qualities before enumerated.

It only remains to be stated, that the real question is, not whether the stroke of an engine shall be 8 feet or 4 feet, but relates to a difference of stroke of probably from 7 feet to 6 feet; that is, whether the reducing of the stroke of a 200 horse engine *one foot*, with a proportionate increase of diameter in the cylinder, can be attended with such injury and inefficiency as shall wholly neutralize or outweigh all the important advantages of the Gorgon engines.

In conclusion, it should be observed that as regards the ordinary beam engines, there are many circumstances of convenience which render it advisable to make the stroke as long as practicable, *i. e.* the adopting of a tall narrow cylinder instead of a short and wide cylinder; for in the arrangement of the ordinary beam engine for marine purposes, it is evident that a considerable space lengthways is required for conveniently placing the slide jackets and passages, the condenser, the hot-well, and the air-pump; this necessarily causes a great elongation of the side levers, or beams; there is, therefore, much local convenience in making the stroke long, and thereby having a tall narrow cylinder instead of a short wide cylinder, less strain is thrown upon the beams; the beams become more close and compact, and afford more space for a passage between and on the off-sides of the pair of engines; the cross-heads and fork-heads become shorter, and have much less strain thrown upon them; these are all very important considerations, which clearly indicate the convenience and positive advantage of having as long a stroke as possible in the ordinary beam engine. But in the Gorgon engine none of these considerations have any weight whatever; here there are neither beams nor cross-heads; we can increase the diameter of the cylinder to almost any extent without any local inconvenience whatever.

We shall conclude these observations with the remark, that as it cannot be proved that there is any superiority in a long stroke engine over a short stroke engine, and as it is also evident that there is no disadvantage whatever in employing a short connecting rod, it is therefore clear that the two objections are decidedly absurd and groundless. Mech. Mag.

On Horn and Tortoiseshell. By A. Aikin, *late Secretary of the Society of Arts, London.*

The subject of the present evening's illustration is the manufacture of horn and tortoiseshell, to which I shall add some particulars respecting whalebone—a substance which, in its physical and chemical properties, bears a great resemblance to horn.

In the English language we have only one word to express two quite different substances—namely, the branched bony horns of the stag genus and the simple laminated horns of the ox genus, and other kindred genera.

The bony horns are called in French *bois*, from their likeness to the branch of a tree: they are annually renewed, and are peculiar to the male sex, ex-

cept in the reindeer, the females of which likewise have horns, though not nearly so large as those of the male.

The other sort of horn, to which the French appropriate the term *corne*, and which is the subject of our present inquiry, is found in the ox, the antelope, the goat and sheep kinds. These are never branched or palmated, but are always of a simple conical figure, more or less curved, and, in some of the antelopes, spirally twisted: they are found in both sexes, but, in the goats and sheep, are much larger in the male than female.

In all these animals, a bony core, of a loose texture and conical figure, rises from the bone of the forehead, covered by a permanent vascular membrane, from the surface of which are produced or secreted thin layers of horn in constant succession. It is supposed that one layer, or rather one set of layers, is produced every year; but, as the former layer remains closely adherent to the new one, such horns are permanent, lamellar in texture, and exfoliate only very slowly from the outside by exposure to weather and friction. The structure of such horns is that of a number of cones or sheaths inserted into one another, the inner of which lies on the vascular membrane that covers the bony core or base. The tip of the horn—namely, that part which projects beyond the core—is very dense, and the layers of which it is composed can hardly be distinguished, whereas the lower parts are of a looser structure, and the layers may readily be seen from the successive terminations of them forming prominent rings, which are very observable on the lower part of the horn. Horn itself is quite insensible, like the finger-nail; and therefore the tip may be cut off while the animal is alive without giving any pain; but if the section is made so low down as to include any part of the core, blood follows, and the animal seems to suffer greatly.

But it is not merely in the defences projecting from the forehead of the genera already mentioned that horn occurs: in the form of nails, claws, or hoofs, it protects and arms the extremities of the toes in all warm-blooded animals, and constitutes the leg-spurs of the cock and other gallinaceous birds. In the form of scales it covers the body of the pangolin, of the armadillo, of the lizard and serpent tribe, and of most fishes, and incloses the tortoises in a kind of plate-armour. It also supplies the hairy covering of the land mammalia, from the fine down of the beaver to the bristles of the wild boar, the horny hair of the elk and the musk, and the spines of the hedgehog and porcupine. The horn of the rhinoceros is not formed upon a bony core, but is merely an aggregation of flattened hairs or bristles adhering by their sides, and presenting longitudinal pores or interstices of considerable magnitude at the base of the horn, and which become smaller towards the point; these interstices in the live animal are filled with a pulpy matter. All feathers likewise, from the plumes of the ostrich to the quills with which we write, and the wing-spurs of the cassowary, are only modifications of horn; so that it may be considered as the general covering of the most highly organized animals.

Horn also occurs where it would not at first be looked for, in the form of plates hanging down from the palate or roof of the mouth in the Greenland whale, and in those others cetaceous animals that are destitute of teeth. This modification of it goes by the common name of whalebone, of which I shall speak more at large hereafter.

The membraneous parts of the animal body are also exceedingly similar to, if not identical with, horn, both in structure and chemical composition: such are the cuticle or scarf-skin which covers the whole body, and separates from the true and sensitive skin on the application of a blister. The

intestines, the bladder, and other thin parts which, on drying, become hard and transparent, are also of the same kind; as likewise are the air-bladders of fish: but these latter also contain jelly.

Certain animal fluids also bear a close analogy to horn in their chemical composition: such are the serum of blood and the white of egg. Both these substances coagulate at a heat less than that of boiling-water, and when afterwards dried, at the common atmospheric temperature, become yellow, transparent, hard, and bear a perfect resemblance to horn, except that their texture is compact, not laminated.

To all the substances above enumerated, chemists give the general name of albumen; and it is distinguished by the following properties from jelly and from fibre, the two other principal organic elements of animal bodies. It does not dissolve in boiling water and fix, on cooling, as jelly does, and by its long resistance to putrefaction it is distinguished from fibre. I may also mention that, when exposed to a decomposing heat in close vessels, it produces a large quantity of that gaseous compound which forms the base of prussic acid; on which account it is that hoofs and the refuse parts of horn are in great request among the manufacturers of Prussian blue.

Almost the only kinds of horn that are the subject of manufacture are those of the bull and cow, and the hoofs of these animals; the horns of the bullock being thin, and of a very coarse texture, are used only for the most ordinary purposes. Our domestic supply is by no means equal to the demand, so that great quantities are imported from Russia, the Cape of Good Hope, and South America.

The first process is the separation of the true horn from the bony core on which it is formed: for this purpose the entire horns are macerated in water for a month or six weeks, according to the temperature; during this time the membrane which lies between the core and the horn is destroyed by putrefaction, so that the core becomes loose and is easily extracted. The cores are not thrown away, but are burnt to ashes, and in this state form the best material for those small tests or cupels employed by the assayers of gold and silver.*

The next process is to cut off with a saw the tip of the horn, that is, the whole of its solid part, which is used by the cutlers for knife handles, is turned into buttons, and is applied to sundry other purposes. The remainder of the horn is left entire or is sawn across into lengths, according to the use to which it is destined. Next, it is immersed in boiling water for half an hour, by which it is softened; and, while hot, is held in the flame of a coal or wood fire, taking care to bring the inside as well as the outside of the horn, if from an old animal, in contact with the blaze. It is kept here until it acquires the temperature of melting lead or thereabouts, and, in consequence, becomes very soft. In this state it is slit lengthways by a strong-pointed knife, like a pruning-knife, and, by means of two pairs of pincers applied one to each edge of the slit, the cylinder is opened nearly flat. These flats are now placed on their edges between alternate plates of iron, half an inch thick and eight inches square, previously heated and greased, in a strong horizontal iron trough, and are powerfully compressed by means of wedges driven in at the ends.

The degree of compression is regulated by the use to which the horn is to be afterwards applied: when it is intended for leaves of lanterns, the pressure is to be sufficiently strong (in the language of the workmen) to break the grain: by which is meant separating, in a slight degree, the laminæ of

* They also constitute a valuable durable manure, the fibrils of the roots penetrating the interstices of the cores, and gradually extracting the rich nourishment which they afford. G.

which it is composed, so as to allow a round-pointed knife to be introduced between them in order to effect a complete separation.

The plates thus obtained are laid one by one on a board covered with bull's hide, are fastened down by a wedge, and are then scraped with a draw-knife having a wire-edge turned by means of a steel rubber; when reduced to a proper thickness and smoothed, they are polished by a woollen rag dipped in charcoal dust, adding a little water from time to time, then are rubbed with rotton-stone, and finished with horn shavings. The longest and thinnest of the films cut off by the draw-knife, when dyed and cut into various figures, are sold under the name of sensitive Chinese leaves (being originally brought from China,) which, after exposure to a damp air, will curl up as if they were alive when laid on a warm hand or before the fire.

For combs, the plates of horn should be pressed as little as possible, otherwise the teeth of the comb will split at the points. They are shaped chiefly by means of rasps and scrapers of various forms, after having been roughed out by a hatchet or saw: the teeth are cut by a double saw fixed in a back, the two blades being set to different depths, so that the first cuts the tooth only half way down, and is followed by the other which cuts to the full depth; the teeth are then finished and pointed by triangular rasps. If a comb or other article is too large to be made out of one plate of horn, two or more may be joined together by the dexterous application of a degree of heat sufficient to melt but not decompose the horn, assisted by a due degree of pressure; and when well managed, the place of juncture cannot be perceived. The Chinese are remarkably skilful in this kind of work, as may be seen in the large globular lantern in the Museum at the East India House, about four feet diameter, composed entirely of small plates of coloured and painted horn. Horn combs are made in London, in York, and in many other English towns; but the chief manufactory of them is at Kenilworth, in Warwickshire.

If a work in horn, such as one of the large combs worn by women, is required to be of a curved or wavy figure, it is finished flat, and is then put into boiling water till it becomes soft, and is immediately transferred to a die of hard wood, in which it is cautiously pressed, and remains there till cold.*

Horn combs ornamented with open work are not made in this country, because the expense of cutting them would be more than the price of the article would repay, but great numbers of them are imported from France. These, however, are not cut, but pressed in steel dies made in London for the French manufacturers; and from an examination of these combs, it is evident that the material must have been in a soft state, approaching to fusion, when put into the die. On referring to French authorities, I find it stated that horn steeped for a week in a liquor, the active ingredient of which is caustic fixed alkali, becomes so soft that it may easily be moulded into any required shape. Horn shavings subjected to the same process become semigelatinous, and may be pressed in a mould into the form of snuff-boxes and other articles. Horn, however, so treated becomes hard and very brittle, probably in consequence of its laminated texture being obliterated by the joint action of the alkali and strong pressure.

Drinking cups of horn are thus made. The horn being sawn to the re-

* Combs among the Romans were made of box-wood.

> Quid faciet nullos hic inventura Capillos
> Multifido *Buxus* quæ tibi dente datur.—Mart. *Epig.* xiv. 25.

quired length is scalded and roasted over the fire, as already described; but instead of being slit and opened, is placed while hot in a conical mould of wood; a corresponding plug of wood is then driven hard in, to bring the horn to shape. Here it remains till cold, and is then taken out and fixed by the large end on the mandril of a lathe, where it is turned and polished both inside and outside, and a groove, or chime as the coopers call it, is cut by a gage-tool within the small end for receiving the bottom. The horn is then taken off the lathe and laid before the fire, where it expands and becomes somewhat flexible; a round flat piece of horn, of the proper size (cut out of a plate by means of a kind of crown-saw,) is dropped in, and forced down till it reaches the chime, and becomes perfectly fixed in this situation and water-tight by the subsequent contraction of the horn as it cools. Capt. Bagnold informs me that he has seen in South America a nest of such cups turned to a thickness not exceeding that of a card, and accurately fitting into each other, the outer one holding about a pint and the inner one little more than an ounce.

Horn is easily dyed by boiling it in infusions of various colouring ingredients, as we see in the horn lanterns made in China. In Europe it is chiefly coloured of a rich, red brown, to imitate tortoiseshell, for combs and inlaid work. The usual mode of effecting this is to mix together pearlash, quicklime, and litharge, with a sufficient quantity of water and a little pounded dragon's-blood, and boil them together for half an hour. The compound is then to be applied hot on the parts that are required to be coloured, and is to remain on the surface till the colour has struck: on those parts where a deeper tinge is required, the composition is to be applied a second time. For a blacker brown, omit the dragon's blood. This process is nearly the same as that employed for giving a brown or black colour to white hair; and depends on the combination of the sulphur, which is an essential ingredient in albumen, with the lead dissolved in the alkali, and thus introduced into the substance of the horn.

In very early times bows were made of horn. Homer describes the bow of Pandarus (*Il.* iv.) as made of the two horns of a wild goat united base to base, reduced into proper form and polished, and then tipped with gold. The bow of Ulysses was also of the same material (*Odyss.* xxi.) The longbow of the English archers was, I believe, entirely of wood; but in the East, even at the present day, bows are made entirely, or in part, of horn. To the kindness of Colonel Taylor I am indebted for the opportunity of exhibiting to you a Chinese bow, made partly of wood and partly of buffalo's horn. The same gentleman likewise informs me, that he has bought in Calcutta pretty good bows, made entirely of buffaloes' horn; but the best Indian bows, those namely of Lahore, are made of horn combined with wood, and strapped round with sinew. Horn lanterns, were also used by the ancients; for we find one mentioned in the *Amphitryo* of Plautus,* and in the epigram of Martial.† Pliny‡ also speaks of horn-lanterns, and says that various other ornamental articles were made of dyed and painted horn.

* Quo ambulas tu, qui Vulcanum in cornu conclusum geris?
Amphitry. Act i. l. 185.

† Dux Laterna viæ clausis feror aurea flammis.
Et tuta est gremio parva lucerna meo.—MART. *Epig.* xiv. 61.

‡ Cornua apud nos in laminas secta translucent, atque etiam lumen inclusum latius fundunt; multasq. alias ad delicias conferuntur, nunc tincta, nunc sublita, nunc quæ cestrotæ picturæ genere dicuntur.—*Hist. Nat.* xi. 45.

Horn was also used as we now employ glass in windows; for which, however, it is not very well adapted, as plates thin enough to be transparent would soon warp, and be corroded by exposure to the weather.*

Horns are also of very ancient use as musical instruments: the true bugle-horn was made of the horn of the urus, or wild bull, tipped with silver, and slung in a chain of the same material.

Another use to which horn has been applied is as a material for defence. I remember to have seen, several years ago, a complete suit of scale-armour made of horn. It was said to have come from Arabia, and seemed very capable of turning the edge of a sword or pistol-bullet.

I now proceed to mention some particulars respecting TORTOISESHELL.

The animal which produces this beautiful substance is a marine tortoise, called the *Testudo imbricata*, or hawksbill turtle. Its Latin name is derived from the mode in which the scales on its back are placed, overlapping one another like the tiles on the roof of a house. In this circumstance it seems to differ from almost all others of its genus; the scales of other tortoises, both those which are land animals and those which inhabit water, either salt or fresh, generally adhering to each other by their edges, like a piece of inlaid work. These plates, in all the tortoises, cover the bony arch of the back formed by the ribs and spine united into one immovable convexity by flat bones stretching from rib to rib, and uniting insensibly with the spine.

The hawksbill turtle is a native of the torrid zone, and is found in the Indian seas as far as New Zealand, on the Coast of Africa, on that of New Granada, in South America, and in many parts of the West Indies, especially on the Mosquito shore and the promontory of Yucatan. Its usual length is about three feet; but specimens have sometimes been found five feet long, and weighing five or six hundred pounds.

The number of plates produced by each tortoise is thirteen; namely, five along the back, and a row of four others on each side: there are also twenty-five, much smaller ones, forming the margin of the shell. The size and thickness of the plates depend on the magnitude and age of the animal, a fresh layer being produced every year; and at the margin of the large plates may be seen distinctly the edges of the layers as they thin off in succession. Sometimes, however, large plates are met with, so thin as to consist, apparently, of only a single layer. The cause of this anomaly I do not know; but some of the dealers in this article have an opinion that these thin plates are the produce of full-grown tortoises that have been stripped of their plates the year before, either purposely or by accident.

The plates are separated by placing the arch of the shell (all the other parts having been removed) over a fire, which soon causes them to start from the bone, by the help of a slender knife. The price of rough tortoiseshell depends on its quality, that is, on its thickness, and the vividness and distinctness of the colours. The present price for fine shell is about three guineas a pound. Not unfrequently the plates are considerably injured by barnacles, limpets, and other shell-fish, which fix themselves on the animal while alive, and prevent the growth of the tortoiseshell on that part which they occupy. Sometimes one or more of the plates will be of a plain yellow colour; and such are in great request among the Spanish ladies, who will give twelve or fourteen dollars for a comb of plain tortoiseshell, while a similar one of the mottled kind will not sell for more than six dollars. The belly-plates of the tortoise are also yellow, and sometimes clear enough to be made use of.

* Corneum specular.—TERTULL. *de Anima*, liii.

The general mode of manufacturing tortoiseshell is the same as I have already described when treating of horn. It is softened by boiling in water; but mere water takes away much of the colour: an addition of common salt prevents this injury; but if too strong a brine is used the shell will be very brittle. Two or more pieces of tortoiseshell may be joined by laying their scraped or thinned edges together, and then pressing them between hot iron. If, however, the heat is too great, the colours are much deepened so as to become almost black, as is the case with moulded snuff-boxes; for tortoiseshell being less fusible than horn, cannot be made soft enough to be moulded without some injury to the colour. Accordingly the manufacturers, at least in England, never attempt to produce tortoiseshell combs with ornamental open work by means of dies, but in the following manner:

A paper being pasted over the tortoiseshell, the pattern is drawn on the paper, and is then cut out by means of drills and fine saws: the paper is then removed by steeping in water, and the surface of the pattern is finished by the graver.

In making small side-combs, it is found worth while, in order to save a costly material, to employ a machine consisting of a cutter working straight up and down, and of a bed (on which the shell is laid,) to which is given a motion advancing by alternate inclination, first to one side and then to the other. By this means the teeth of two combs are cut at the same time, those of the one occupying the intervals of the other. Such combs are called *parted*, the saw not being used upon them; and are often made of fine stained horn instead of tortoiseshell. Tortoiseshell is also used for inlaying tables, cabinets, and other ornamental articles, a metallic foil being placed below it to give lustre and colour. This employment of it appears to be coming at present considerably into fashion.

Among the Romans of the Augustan age, this taste was not so much a fashion as a fury. The frames of the couches on which they reclined at table were covered with the largest and most beautiful plates that could be procured of tortoiseshell;* and it was employed for various other similar purposes: but I am not aware that it was ever used by them as a material for combs. It was brought by Indian and Arabian traders from the islands in the Indian Sea to Adulis,† in Abyssinia, together with ivory, rhinoceroses' horns, and hippopotamuses' hides. Here it was purchased by Egyptian merchants, was transmitted to Alexandria, and thence passed to Rome and the other great cities of the empire. For modern uses, thick tortoiseshell is more valuable in proportion than thin; but among the Romans, where it was used only for inlaying, veneers were cut out of it. This art was the invention of one Corvilius Pollio, a man, as Pliny‡ says, of singular sagacity in all things that ministered to a prodigal luxury.

* Attonitus pro
Electro signisq. suis Phrygiâ columnâ
Atq. Ebore, et latâ Testudine.—Juven. xiv. 306.
Ut testudineo tibi, Lentule; conopeo
Nobilis Euryalum myrmillonem exprimat infans.—*Ibid.* vi. 80.
Gemmantes primâ fulgent Testudine lecti.—Mart. xii. 66.
Et Testudineum mensus quater hexaclinon.—*Ibid.* ix. 60.
Varios—pulchrâ Testudine postes.—*Georg.* ii. 463.

† Opidum Aduliton—maximum hic emporium Trogloditarum, etiam Æthioprum,—Deferunt plurimum Ebur, Rhinocerotum cornua, Hippopotamorum coria, chelyon Testudinum. —Plin. *Hist. Nat.* vi. 34.

‡ Testudinum putamina secare in laminas, lectosque et repositoria his vestire, Corvilius Pollio instituit, prodigi et sagacis ad luxuriæ instrumenta ingenii.—Plin. *Hist. Nat.* ix. 13.

Whalebone, as I nave already stated, may be considered as a kind of horn; which latter substance it resembles perfectly, both in its chemical and principal physical properties, and is particularly interesting as forming the transition from horn to hair.

It is the substitute for teeth in the Greenland whale, and in the black southern whale, but is not found in any of the cetaceous animals that have teeth.

The food of the Greenland whale is a small crustaceous animal, not so large as a common shrimp; and the whalebone forms the apparatus by which this huge animal secures the minute prey that he lives on. From the roof of the mouth hang down on each side of the tongue about three hundred blades of whalebone, all the blades on one side being parallel to each other, and at right angles to the jaw-bone. On account of the arched form of the roof of the mouth, the blades about the middle of the series are the longest, and they diminish gradually towards each end. The average length of the middle blades is about nine feet; but they have occurred of the length of fourteen or fifteen feet. These blades hang down in the mouth so that the hairy side shall be the innermost; the hairs forming a net or filter through which the water escapes, leaving the shrimps behind.

The surface of the blade is compact, and susceptible of a high polish by mere friction. Its texture is lamellar in the direction of its breadth, so that it easily splits and divides in this direction, but not in that of the thickness of the blade: the middle of the blade is of a looser texture than the rest, and is technically called the grain, being composed of coarse, bristly hairs. The general colour of whalebone is a dusky greyish black, intermixed with thin strips, or layers of a paler colour, which are often almost white—very rarely the entire flake is milk-white.

The preparation of the whalebone for use is very simple. It is boiled in water for several hours, by which it becomes soft enough to be cut up, while hot, in lengths of different dimensions, according to the use to which it is to be applied; or, by means of a compound guarded knife, is cut into fibres for brushes, which are at present extensively used in stables for the first process in cleaning a horse. Whalebone that has been boiled, and has become cold again, is harder and of a deeper colour than at first; but the jet-black whalebone has been dyed. The principal consumption of whalebone at present is for stretchers to umbrellas and parasols: it is also used, though not so much as formerly, in giving stiffness to women's stays. Whips are also made of platted whalebone, both black and white: the latter are very beautiful. White whalebone has also been made into ladies' bonnets, and likewise into artificial flowers, as its texture is well adapted to this purpose; and it will, by the usual dying processes, take very bright and durable colours.

Trans. Soc. Arts.

On moistening the Air in Hot-houses. By T. Appleby, *Gardener.*

The successful cultivation of orchidaceous plants being now almost an essential qualification for every gardener, I am induced to add my mite to the many useful directions that have appeared in your interesting miscellany. It is in consequence of having adopted something new (at least to me) in the method of moistening the air in our orchidaceous houses, that I am induced to send you the following account of our success.

We have two houses devoted to the culture of this interesting and fashionable family of plants. They are heated by hot water, one with round

pipes, the other with square ones; and, although we had pools inside, and frequently wet the floors and the pipes, yet we still found the air much too dry. To overcome this many were our projects, and in the end it was resolved to put up a small steam boiler with a main pipe to convey the steam inside, and branch pipes to different parts, in order to fill the houses completely and equally at once with steam. This, after some little failures, and various trials, we have at length happily accomplished. The effect had far surpassed my most sanguine expectations. In twenty minutes after lighting the fire, the houses are so filled with steam that I cannot see the plants, when I am in the houses, at two yards' distance; whilst the plants themselves are covered with the finest dew imaginable, and though they have been immersed in this vapor twice a day, an hour each time, for now nearly two months, they are not in the least injured, but on the contrary highly benefited. Plants that had been at a stand here for eighteen months are now beginning to grow, while others that were sickly are now fast recovering. The most delicate flowers are not injured, nor their duration shortened; whilst many species, considered difficult to flower, are now showing buds. The benefit to those plants which are hung up in baskets, or fixed to blocks of wood, is very apparent.

I may also mention that we grow a few of the choicer stove plants amongst the Orchideæ, and their appearance shows that they derive benefit from the vapor with which they are surrounded. Some of these were infested with the red spider, but this warm vapor bath was fatal to the insects, as indeed was naturally to be expected.

Having thus related to you our success, I shall now endeavor briefly to describe the apparatus by which it is effected.

The boiler is placed in the back shed, and is made of copper, and weighs 80 lbs. with the taps included. It is furnished with a safety valve, a tap and funnel at the top to pour in the water, a tap at the bottom to let out the water, another to show when there is water in sufficient to allow room for steam to be generated, and a tap at the top with a small pipe attached which nearly reaches down to the bottom of the boiler. This last is to show when the water is too low, which it does by permitting steam to escape, which would not be the case so long as the end of the attached small pipe was covered with water.

The pipe that conveys the steam into the houses is $1\frac{1}{4}$ in. in diameter; it rises from the boiler 3 ft., and is then carried through the back wall down to the floor inside, under the back stage; it then branches right and left to each end of the houses; is then led across each end, and on the front; the branches on the ends and in the front being reduced to 1-inch pipe. In those pipes, and also on the back, are holes drilled every six ft., into which holes small pipes 6 in. long are screwed. These small short pipes are in the form of the letter T, to throw the steam horizontally, so as to diffuse it through the air before it reaches the pots or plants.

We soon found the small pipes on the main back one were not necessary, as the steam spread itself from the front and ends quite sufficiently for our purpose. The cost of fuel for this apparatus is but trifling, and the steam and the pipe that contain it heat the houses so much, that a very considerable saving of coals in the hot-water boilers is the consequence. We have therefore attained two objects; the supplying of moisture to the internal atmosphere most effectually, and a saving of fuel.

The boiler and pipes and fitting up cost about 13*l.*; but, if we had had an iron boiler instead of copper, it would not have cost more than 10*l.*

The question now is, whether the above method is worthy of imitation. All I can say on the matter is, that both Mr. Brocklehurst (my spirited employer) and myself are perfectly satisfied with it, and I shall be happy to give any further information to you or any of your readers who may require it. Gardener's Mag.

Extraordinary Manner of Manufacturing Cloth.

A gentleman, residing at present in London, has just obtained, we are told, a patent for making the finest cloth for gentlemen's coats, &c., without spinning, weaving, or indeed without the aid of any machinery similar to those processes, and at a cost less than one-fourth the present price. The most extraordinary circumstance in this contrivance is, that air is the only power used in the manufacture of the article. The ingenious inventor places in an air-tight chamber a quantity of flocculent particles of wool, which by means of a species of winnowing-wheel are kept floating equally throughout the atmosphere contained therein; on one side of the chamber is a net-work of metal of the finest manufacture, which communicates with a chamber from which the air can be abstracted by means of an exhausting syringe, commonly called an air-pump, and on the communication between the chambers being opened the air rushes with extreme vehemence to supply the partial vacuum in the exhausted chamber, carrying the woolly floccula against the netting, and so interlacing the fibres, that a cloth of a beautiful fabric and close texture is instantaneously made. Several of the specimens of this cloth that have been shown to scientific gentlemen and manufacturers have excited great admiration. This cloth is a species of felt, but instead of adopting the old laborious method, the above, which is denominated the pneumatic process, is used, and produces the result as it were by magic. Arch. & Civ. Eng. Journ.

Kalsomine.

A new and inodorous sort of paint, the invention of Miss Fanny Corbaux has been lately introduced to public notice. The materials of which it is composed are at first soluble in water; and while in this state admit of the design being effaced, or a portion of the coloring of a wall or ceiling being removed, if necessary; a subsequent operation renders the paint insoluble, by a chemical change of the properties of the material, which fixes the colour durably. It is free from any offensive smell, dries in a few hours, is not acted upon injuriously by atmospheric influences, and is said to be more durable than oil paint, as well as more agreeable to the eye, and not at all prejudicial to the health; indeed a room painted with it one day, may be inhabited the next. It may also be made applicable to easel painting also. We have seen a little landscape painted with this material, which combined something of the depth and solidity of oil with the transparency of water-colour; and a specimen of broad flower painting, for a room, was shown us, which possessed remarkable purity of tone, and a brilliancy of effect superior to any ornamental painting we have seen; and which had resisted the rude action of the scrubbing-brush. The effect of the white, as a ground for gilding, is extremely clear without being dazzling; and we can well understand that it possesses the property ascribed to it of "softening and diffusing light." Athenæum.

Progress of Physical Science.

Experiments and Observations on Light which has permeated coloured Media, and on the Chemical Action of the Solar Spectrum. *By* Robert Hunt.

M. Gay Lussac, when speaking of the beautiful discovery of M. Daguerre, said, "the palette of the painter is not very rich in colour; black and white compose the whole. The image, in its natural and varied colours, may remain long, perhaps forever, a thing hidden from human sagacity."*

However, the production of a coloured picture of the spectrum by Sir John Herschel, and some effects produced by Mr. Talbot, together with some delicate tinting which I observed, when, during the summer of 1839, I was engaged in copying some flowers of Nature's richest painting, led me to think coloured photographs within the range of probabilities, and induced me to pursue a train of experiments, from which, although little has resulted to heighten my first hopes, I have gathered much that is curious and certainly instructive.

Photographic Papers.

1. By saturating paper with different chlorides and muriates, always keeping in view the definite proportion required for the quantity of nitrate of silver used; it will be found that almost every variety of shade, from a rich dark purple to a full red, and a few other tints, may be produced at pleasure.

2. The effects of light, passing through coloured glasses on various papers, are singularly diversified. The following are a few of the most striking results. (The glasses are, a deep cobalt blue, a full laurel green, an amber yellow, and a rich orange red. They are so framed that all the papers can be exposed at the same time to the solar influence.)

Colour of Glass.

Salt used.	*Blue.*	*Green.*	*Yellow.*	*Red.*
	Effects produced.			
a. Chlor. of sodium.	Purple.	Blue.	Violet,	Chocolate.
b. Chlor. of potassa.	Light purple.	Sky blue.	Light violet.	Tinted red.
c. Muriate of lime.	Rich violet.	Faint blue.	Blue.	Reddish.
d. Muriate of iron.	Red.	Colourless.	Faint red.	Leaden hue.
e. Muriate of peroxide of iron.	Blue.	Yellowish.	Straw colour.	Yel. brown.
f. Mur. of baryta	Purple red.	Lilac.	Chocolate.	Pink.
g. Muriate of manganese. . .	Rich brown.	Reddish.	Rose hue.	Yellow.
h. Mur. of ammonia.	Olive brown.	Pale brown.	Brown.	Dull orange.

3. I have found but a modified action from the interference of coloured fluids. In a few instances, under a solution of carmine in ammonia, I have obtained the richest crimson dye; but I cannot, by any means I have used, succeed in fixing the colour on the paper.

* The History and Practice of Photogenic Drawing, &c., by L. J. M. Daguerre. Translated by J. S. Memes, LL. D."

4. A paper prepared, by first washing it with a solution of twelve grains of iodide of potassium in one ounce of water, and then with a solution of ten grains of the crystalized nitrate of silver in the same quantity of fluid, is very sensitive. When exposed beneath a solution of the ammonia-sulphate of copper to sunshine, it changes to a rich *light blue*. Acetate of copper produces a *brown*. Muriate of the peroxide of iron imparts a *green tinge*, and solutions of carmine a *brown red*.

5. The paper, *f*, becomes *red*, when acted on by rays passing through nitrous acid gas, and is tinged *yellow*, by the light which has been subjected to the interference of chlorine and its protoxide.

6. To have as full a volume as possible of iodine and bromine vapour, carefully closed vessels, containing a small portion of these bodies, were placed upon a plate of copper warmed by water.

The paper, *h*, was laid beneath them, and exposed to luminous influence. Under the bromine it was unchanged, but beneath the iodine the paper became richly iridescent. The colours changed to a uniform violet tint upon a few minutes exposure to direct sunshine.

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7. Papers already darkened by sunlight during prolonged exposure to the influence of the dissevered rays of the spectrum, assume a variety of colours. The same changes may be effected by carefully arranging glasses, and placing the photographic preparations beneath them. I shall copy exactly the memoranda of my journal.

Dec. 12, 1839.—I placed under blue, green, yellow, and red glass, the following papers:

A. *Muriate of ammonia*, with two washings of solution of the nitrate of silver, darkened by exposure to a rich chocolate.

B. *Muriate of manganese*. Silver, two washings, darkened to a full brown.

C. *Iodide of potassium*. Silver, one washing, darkened to a yellow brown.

D. *Iodide of potassium* and silver, two washings, darkened to a red brown.

E. *Chloriodic acid*. Silver, two washings, darkened to a rich bronze.

F. *Chloriodic acid* with *Liquor potassæ*. Silver, two washings, darkened to a blue brown.

Dec. 13.—After twelve hours exposure to the dull light of rainy weather, the paper, E, has become blue under the blue glass. No change is apparent on the others.

Dec. 27. *Colours of Glass.*

	Blue.	*Green.*	*Yellow.*	*Red.*
A. has become	Olive.	Deep green.	Dirty yellow.	Red.
B. do.	Deep brown.	Bat colour.	Blue brown.	Red.
C. do.	do.	Darkened.	No change.	Red brown.
D. do.	Black.	Light brown.	Rich brown.	Brick red.
E. do.	Blue black.	Darkened.	Darkened.	Dusky red.
F. do.	Black brown.	Dull plum.	Bluish.	Reddened.

Jan. 2, 1840.—All the papers go on increasing the distinctness of their colours, except **E** and **F**, which have assumed different shades of blackness.

(*E and F were removed, and a paper,* **G**, *prepared with muriate of baryta and two washings of silver, darkened to a chocolate, substituted.*)

Feb. 7. *Colours of Glass.*

	Blue.	*Green.*	*Yellow.*	*Red.*
A. has become	Rich olive.	Green.	Yellow.	Purple.
B. do.	Black.	Chocolate.	Light brown.	Red.
C. do.	Do.	Red brown.	Do.	Brown.
D. do.	Chocolate.	Umber brown.	Black.	Red brown.
G. do.	Bright olive.	Yellow brown.	Pale olive.	Reddish.

The two papers, A and G, exhibit much more sensitiveness to luminous influence than any others I have yet tried.

8. The paper, A, when washed with a weak solution of the hydriodate of baryta, gives under the pencil of light a beautiful picture, whether used in the camera or for surface drawings.

These pictures exhibit the peculiarities mentioned by Mr. Talbot at the British Association.* Sunshine changes "the colour of the object delineated from reddish to black with great rapidity." This gentleman adds, "after which no further change occurs." I much regret I have not been fortunate enough to succeed thus far in fixing my drawings. The continued influence of light in a few months obliterates the impression.

A singular change follows the exposure of these pictures to coloured light.

If placed under vessels containing coloured fluids, (4) and exposed either o sunshine or diffused light, in a few days the picture becomes a full *red* under the blue; a *rose hue* under the green; a *light blue* under the yellow, and a *deep blue* under the red. These colours, after deepening for some time, gradually change to different shades of green under the blue and green fluids, to a pink under the yellow, and a red under the red fluid (25.) After this, the colours alter no more, and the picture bears exposure to light much better than at first: but I doubt if it is rendered permanent, for the dull light of January and February has spread a downiness, like a mist, over those photographs which have been constantly exposed.

Daguerreotypes.

9. Exposing a plate, over which some lace was carefully placed, under four coloured glasses (2.) for three minutes to diffused light, I obtained, under the blue glass, a beautiful copy; no trace of a drawing beneath the green; a tolerable impression beneath the yellow; but the mercury would not attack the space beneath the red.

10. A plate similarly arranged beneath four bottles of coloured fluid (4.) exposed to diffused light for fifteen minutes, was found, on being acted upon by the mercurial vapour, to present the same appearance as above, (9.) excepting that a faint design was evident over the space the carmine fluid had covered.

11. I arranged a dark chamber, to which no other rays could pass but such as had permeated *two inches* of coloured fluid.

Having filled my trough with a saturated solution of the bichromate of potassa, I exposed a plate for five minutes to its influence in full sunshine. *There was not the slightest action.*

12. In one hour, on a similar plate, under the same circumstances, I obtained a faint but still defined outline of a dried fern.

13. I exposed a bare iodidated plate for two hours to the same influence.

* Athenæum, No. 618.

On removing it from the chamber, no difference was apparent; but I found it was no longer sensitive to light, and the iodide adhered more closely to the metal than it did (28.)

This is a reverse action, for after the exposure of a prepared Daguerreotype plate to light, the sensitive film is most easily rubbed off* (28.)

14. Red solutions impart a very decided rose hue, or more strictly speaking, the influence of red light on the iodidated plate occasions that peculiar arrangement of the mercurial particles, which is necessary to the production of red colour.

15. Green solutions act with more or less effect in obstructing the passage of the so-called chemical rays, according to their depth of colour. But in no instance have I found them to produce that close combination which the yellow and sometimes the red fluids do, of the iodide and the under surface of unattacked silver (28.) By examining the effects produced by green media (2, 7, 16.) a peculiar order of interference will be remarked (19.)

Germination and the Growth of Plants.

16. I planted in a box some curled cress seed, and so arranged bottles of carmine fluid, chromate of potassa, acetate of copper, and the ammonia sulphate, that all but a small space of the earth was exposed to light which had permeated three-fourths of an inch of these media.

For some days, the only apparent difference was that the earth continued damp under the green and blue fluids, whereas it rapidly dried under the red and yellow. The plumula burst the cuticle in the blue and green lights, before any change was evident in the other parts.

After ten days, under the blue fluid there was a crop of cress, of as bright a green as any which grew in full light, and *far more abundant.*

The crop was scanty under the green fluid, and of a pale unhealthy colour (15.)

Under the yellow solution but two or three plants appeared, yet they were less pale than those which had grown in green light. Beneath the red bottle the number of plants which grew was also small, although rather more than in the spot the yellow covered. They too were of an unhealthy colour.

17. I now reversed the order of the bottles, fixing the red in the place of the blue, and the yellow in that of the green. After a few days exposure, the healthy cress appeared blighted, while a few more unhealthy plants began to show themselves from the influence of the blue rays, in the spot originally subjected to the red.

It is evident from this, that the red and yellow rays not merely retard germination, but positively destroy the vital principle in the seed. Prolonged exposure uncovered, with genial warmth, free air, and indeed all that can induce growth, fails to revive the blighted vegetation.

I have repeated the experiments many times, varying the fluids, but the results have been the same. At this time I have the above facts strikingly

* On this principle I now polish my silvered plates, by which the troublesome process with nitric acid and pumice is got rid of. I wash the surface of silver over with a solution of the iodide of potassium holding a little iodine free, and rub it lightly until all the parts are equally attacked. I then expose the plate to light for a few minutes, and polish off with dry cotton. In five minutes, by this process, the most perfect lustre may be given to the silver, and it has the advantage of rendering the plate more susceptible to the influence of the iodine vapour.

exemplified where the space covered by the bichromate of potassa is without a plant.

These results merit the attention of those who are engaged in the study of vegetable economy. Do not they point at a process by which the productions of climes more redolent of light than ours may be brought in this island to their native perfection?

Dr. Draper's "experiments" (Philosophical Magazine, Feb. 1840, pres. vol. p. 81) appear at variance with mine.

Under the influence of a nearly tropical sun permeating half an inch of solution of the bichromate of potassa, cress grew of a green colour, whilst it took five days to give a sensitive paper a faint yellow green colour. From this Professor Draper argues the existence of two classes of rays, a different class being necessary to produce the green colouring of vegetable foliage from that which darkens chloride of silver.

With submission to one whose facilities for such inquiries are so much greater than my own, I would suggest a repetition of the experiments with some of the recently discovered photographic preparations. The papers, *f*, and *h*, both under coloured glass and great thicknesses of yellow fluid, are deepened to a plum-brown in less than an hour.*

Under three inches of the bichromate of potassa, the paper, *f*, became, in eight hours sunshine, of a full blue-brown.

18. The fact of cress and peaplants growing green, under the influence of such powerful light as penetrated Professor Draper's yellow media, will not appear at all surprising when we examine the rays which pass through such fluids.

This I have done by forming a spectrum, interposing the coloured body between the prism and the sun. The following are the effects of February sun at Devonport.

Through a deep blue solution of the ammonia-sulphate of copper, the violet, indigo, blue, and a portion of the green rays pass.

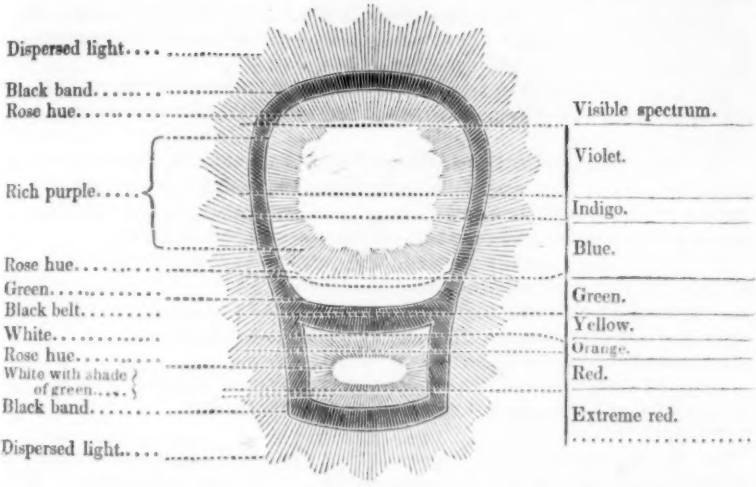
Through solutions of the muriate, acetate, and nitro-muriate of copper with iron, the green ray, and a considerable portion of the yellow; a trace of the blue also is evident.

Through solutions of the bichromate and chromate of potassa, the chloride of gold and decoction of turmeric, the red, the yellow, and the green rays are seen, *and by taking their impression on a Daguerreotype plate, a line of the blue is distinctly marked.*

Through nitro-muriate of cobalt in ammonia, carmine in ammonia, and sulphuric acid and decoction of cochineal, the red and yellow rays alone appear to penetrate.

* The papers which accompany this article were exposed under the glasses and three-fourths of an inch of fluids for forty minutes. The order of interference and consequent colouring is plainly shown.

The Spectrum.



19. It will be observed, that the light which has passed through a green medium (2, 7, 9, 10, 15, 16.) acts less powerfully in darkening photographic papers, and occasions vegetable leaves to be even paler than that which has been subjected to the interference of a yellow medium.

I am led to suspect that the band of rays formed by the meeting of the yellow and the green has an influence similar to the extreme red, in neutralizing the powers of the other adjacent rays, as was first noticed by Sir John Herschel, (22.,) (23.,) (26.)

20. The annexed figure represents the solar spectrum, as it impresses itself on a Daguerreotype plate, not in shadows merely, but in colours, which have the peculiar appearance of the down upon the nectarine.

The most refrangible portion of the spectrum is represented in full colours, shading from indigo to a delicate rose, which is lost in a band of pure white.

21. Beyond this a protecting influence is powerfully exerted, and notwithstanding the chemical effect produced over the plate, by the dispersed light, a line is formed free of mercurial vapour, and which consequently appears black.

22. The green portion of the spectrum is represented in its true colour, but it is considerably less in size than the space occupied by these rays.

23. The yellow rays are without action, or rather they do not prepare the silver for the reception of the mercury, and consequently a black belt marks the space on which they fell, and extends a little beyond it into the green (19.)

24. A white line marks the place of the orange light.

25. The red is represented by a well defined rose colour, bounded, as

were the more refrangible rays, by a white line, shaded, at the lower extremity, with a green.

This passing of the red into a green, and of the blue into a rose colour, (20.) is strikingly similar to the effect produced, by the interference of coloured media, on some photographic drawings (8.)

26. The lowest dark space on the picture is a beautiful illustration of the influence of the extreme red rays in protecting the silver from luminous action (19.) (21.)

27. What appears more surprising to me than even the detection of the *negative?* rays at each end of the prismatic spectrum, is the continuation of the dark line throughout *its whole length*, evidently showing the influence of the same cause as is so effective at the least refrangible extremity.

This band is not equally defined throughout its entire circumference. It is the most strikingly evident from the extreme red to the green; it fades in passing through the blue, and increases in intensity as it leaves the indigo, until, beyond the invisible chemical rays, it is nearly as strong as it is at the calorific end of the spectrum.

Does not this protected surrounding band appear to indicate the existence of rays of a peculiar and unknown order, proceeding from the extreme edge of the sun?

28. By lightly rubbing a Daguerreotype picture of the prismatic rays, it is obliterated, except over the space of the yellow and red portion. This effect corresponds with my experiments on media of these colours (11. 12. 13.)

Until we have more experience than we now have of the effects of the solar rays individually and collectively, we can offer no satisfactory explanation of the process in action, on a Daguerreotype plate, by which the subtle painter, Light, impresses such delicate designs.

The existence of two iodides of silver, is, I think, certain. In my photometric experiments, I have always observed the formation of an iodide which speedily darkens, and of another portion which is unalterable by light.*

The sensitive film on the silver plate appears to be the former of these iodides. Throughout the range of the chemical spectrum, *particularly so called*, the iodide is I imagine converted into an oxide of silver; that a partial oxidation takes place, numerous experiments have rendered certain; whilst the influence of the rays of least refrangibility is to form the unchangeable iodide of silver. Experiments, however, are wanting to prove this satisfactorily.

An attentive consideration of the facts I have enumerated, will, I think, satisfy all, that we can no longer with propriety attach the name of chemical to the most refrangible rays only. Every ray has its particular chemical office, either of composition or of decomposition; and although Seebeck has attributed the acquirement of a rose hue by chloride of silver when put into the red ray, to the heating power of that portion of the spectrum, it is now proved to be dependent upon some other influence, for where it has been shown the most calorific rays exist, this salt undergoes no change.

Devonport, February 29, 1840. Lond. & E. Philos. Mag.

* See Mr. Talbot's account of the processes employed in Photogenic Drawing Lond. and Edinb. Phil. Mag., vol. xiv., p. 210 (2.)—Edit.

Deep Soundings.

The following extract of a letter from Capt. James Ross, R. N., to the hydrographer of the Admiralty, will interest our readers. It will be seen that the mean velocity of the weight in descending 2677 fathoms was 3.2 per hour; the first 50 descended at the rate of 7.1 miles, and the last 100 at 2.4 miles per hour. This is one thousand fathoms less than the soundings in the last number.

H. M. S. Erebus, at sea, 3d March, 1840.

(Lat. 33° 21′ S. long. 9° 4′ E.)

"I have just obtained another deep sounding, and although we have not yet been able to get down so far as I wished, and still hope to do, I am quite satisfied that if we get into any sea deep enough, we shall have no difficulty in accomplishing it. The weight employed was 540 lbs., and we had on the reel something more than 5000 fathoms of line: the first 437 fathoms were a single strand of whale line; the rest was of two strands of three-yarn spunyarn, and the following are times of each of the marks passing off the reel.

	h.	m.	s.	Intervals. m.	s.
Let go at	10	33	58		
50 fathoms		34	23	0	25
100		34	53	0	30
150		35	22	0	29
200		35	54	0	32
250		36	26	0	32
300		37	3	0	37
350		37	40	0	37
400		38	20	0	40
477		39	32		
next 100		40	59		
200		42	31	1	32
300		44	8	1	37
400		45	48	1	40
500		47	28	1	40
600		49	14	1	46
700		51	2	1	48
800		52	58	1	56
900		54	56	1	58
1000		56	56	2	0
100		58	56	2	0
200	11	0	56	2	0
300		2	55	1	59
400		5	2	2	7
500		7	14	2	12
600		9	27	2	13
700		11	42	2	15
800		13	58	2	16
900		16	19	2	21
2000		18	44	2	25
100		21	11	2	27
200		23	37	2	26
				stopped exactly at the mark.	
Total 2677 fathoms= 3 miles 74 yards.		29	39	time of sounding	

Crozier took down the time of each mark passing off the reel, and when the weight struck the bottom, it stopped so suddenly that the boats' crew all called out, "It is down." We veered away 50 fathoms afterwards, and then hauled in again, but could not get an inch more than the mark at which it first struck. Nothing could be more satisfactory than this sounding, and it is the more so from shewing very plainly that we have the means of getting soundings however deep the sea may be, and I trust our next trial will be in deeper water. I have ordered the line to be again completed to 5000 fathoms; but it would be useless to attempt it any more on this side of the Cape. JAMES F. ROSS.

Naut. Mag.

On Certain Effects of Temperature. By C. T. COATHUPE, *Esq.*

Having, from the nature of my occupations, an excellent laboratory for observing the effects of temperature, I beg to offer you some experiments illustrative of some of these effects.

A modern glass-house is generally a cone built of brick, having its interior diameter, at the base, varying from 58 to 60 feet, and its perpendicular height varying from 90 to 100 feet. The upper aperture through which the smoke ascends, varies from 9 feet 6 inches to 10 feet in diameter. This cone terminates at its base in substantial pillars of brick about 3 feet square, following the exterior inclination of the surface of the cone, and united above by arches which spring from pillar to pillar, and below by inverted arches beneath the ground.

Around the centre of the interior floor of this cone, the furnace is erected; and around the exterior of the pillars which support the main body of the cone, the glass-house is extended by shed roofs, whose rafters bear against the exterior of the brick cone, above the arches which connect the pillars. This extension constitutes the manufacturing workshop, or space occupied by the glass-making operatives. The interior space around the furnace and within the pillars, is that occupied by the founders, or the men whose duty it is to fill the pots with raw materials for the production of glass, to urge the fire, to examine from time to time the state of fusion, and in short, to make from sand, alkali and lime, by the aid of intense heat, the material which the glass-making operatives subsequently convert by manipulation into glass.

For very many consecutive hours during the process of founding the raw materials, a thermometer placed at the greatest possible distance from the furnace, but within the area occupied by the founders, and freely suspended from a rod projecting from the interior surface of one of the brick pillars (a distance in the present instance = to 20 feet 5 inches,) will indicate a temperature varying from 316° to 325° of Fahrenheit. The founders have cool recesses, into which they frequently retire during their work, but the average of temperature here mentioned, viz: from 316° to 325°, and frequently very much beyond 325°, they bear without experiencing any inconvenience whatsoever. Strangers universally wonder at the possibility of human beings existing in a situation in which their clothes are continually scorched, while their naked skin exhibits no marks of the effects of fire. I had myself often wondered at the circumstance, until I made some experiments to endeavour to ascertain the cause of such an anomaly. The results of some of these experiments are curious from the extent of the ranges of

the temperatures, and I have much pleasure in proffering them to those of my philosophical brethren who may feel an interest in such matters.

Exp. 1. Two silver brass scale thermometers, having each a range of 600° Fahrenheit, were suspended from an iron pin at a distance of two inches from the interior surface of one of the brick pillars of the glass-house, at a distance of 20 feet 5 inches from the nearest point of the furnace emitting flame, and during the early part of the founding process.

They both indicated, from an average of ten simultaneous pairs of consecutive observations which ranged well together, a temperature of 194°.4 Fahrenheit.

Exp. 2. One of the thermometer bulbs was now clothed with a thin case of fine black "merino." The average of ten simultaneous pairs of consecutive observations indicated a difference of temperature manifested by the clothed bulb, in excess of that manifested by the unclothed bulb, of 23°.1 Fahrenheit upon each pair of observations. Hence 23°.1 of Fahrenheit were retained by the covered bulb, which were evidently reflected, and lost to observation, by the bright metallic surface of the unclothed bulb.

In another series of experiments, wherein the temperature indicated by the unclothed thermometers averaged only 124°.5 Fahrenheit, from twelve pairs of observations, the increment shown by covering one of the bulbs with a thin bag of black "merino," amounted to 34°.66 Fahrenheit. Hence the quantity of heat that is reflected from the bright surface of a thermometer diminishes as the heat itself increases.

Exp. 3. During the latter part of the founding process and whilst the clothed thermometer suspended from the brick pillar ranged from 320° to 325° Fahrenheit, a small black iron cylindrical pan, filled with water, was placed upon a thin iron shelf, which had been fixed against the pillar and close by the side of the thermometer. It was reasonably anticipated that water thus placed in a temperature of 320° to 325° would boil; but after waiting until the half of it had evaporated, it showed no tendency to ebullition.

Exp. 4. The top of the iron pan was now covered with a pane of window-glass, and in a few minutes it boiled violently. This experiment demonstrated that the cooling properties of rapid evaporation can neutralize one of the direct effects of heat to a very surprising extent, and to ascertain the amount of this influence the following experiment was instituted.

Exp. 5. A clothed thermometer, whilst the mercury was indicating a temperature of 310° Fahrenheit, was immersed in a vessel of boiling water. the mercury *instantly* fell to 212°, and then *very gradually* sunk to 141°. The merino envelope had become dry, and the mercury had commenced rising when the bulb was immersed a second time into the water. The mercury rose to 202°, and then gradually fell to 139°. By a third immersion the mercury rose to 198°, whence it fell *gradatim* to 133°. The envelope was now saturated with water at about 140° Fahrenheit, but the mercury speedily reassumed the temperature of 133° Fahrenheit, and remained at this fixed point for nearly five minutes, although the real temperature of its situation was, and had been for many previous hours, 310° Fahrenheit.

The effects of rapid aqueous evaporation were thus clearly shown to influence the indications of the thermometer when placed in a dry atmosphere of 310° Fahrenheit, and under the circumstances described, to the surprising extent of 177° Fahrenheit.

We may now infer that the *copious perspiration* which exudes from the skin of glass-makers, and of those who are engaged in similar scorching

occupations, is a sufficient protection from the burning effects of a *dry* atmosphere of from 300 to 400 *degrees of Fahrenheit;* and that whilst the clothes of such persons are burning to tinder, their skin may be rendered insensible to the direct effects of the fire upon the inanimate matter around them, by simple natural laws, viz: those of evaporation.

Having been engaged in some delicate experiments on the subject of heat, I was surprised at the effects of comparatively moderate *dry* temperatures upon such thermometer scales as were made of ivory.

In one instance the scale became shortened two degrees in 100 in a temperature of 212° Fahrenheit.

In another, an old and "well-seasoned" ivory scale, that had often endured the maximum solar heat of Jamaica and the salt waters of the Atlantic, became shortened one degree in 110° from a *dry* temperature of 130° Fahrenheit.

In a third, the scale became shortened $1\frac{1}{2}$° in 120° from a short exposure to a *dry* heat of 260 Fahrenheit. Immersion in water will generally restore such scales to their original length. Lond. and Edin. Philos. Mag.

Progress of Civil Engineering.

Resistance of Air to Railway Trains. By Dr. Lardner.

At the Liverpool meeting of the Association, in the autumn of 1837, an inquiry was undertaken by Dr. Lardner, in connexion with some other members of the Association, with a view to determine the mean numerical value of what were called *Railway Constants* by analogy to similar numerical quantities in other branches of science and art. *Constants* is a technical name given to certain quantities, more especially in astronomical and physical science, which enter largely into general calculation. As an example of these, may be mentioned, the height through which a body falls in a second of time; the length of a second's pendulum; the ratio of the circumference of a circle to its diameter, and so on. A project of a magnificent kind was formerly suggested by Mr. Babbage, for the determination of the mean numerical values of the "Constants of Nature and Art." Among these quantities which enter railway calculations, that which is of the greatest practical importance, is the number by which is expressed the proportion which the tractive power, necessary to move loads on a railway, bears to the weight of the loads it moves. The great importance of this will be really perceived, if it be considered that such is in fact in a great degree the ratio of the cost to the work done. Accordingly, the first point to which this inquiry was directed was, the solution of that problem.

The resistance opposed by a railway train, to the power which draws it, arises from several causes: 1st, the friction or attrition of the axles of the wheels in their bearings; 2d, the rolling friction of the tires of the wheels upon the rails; 3d, the resistance of the air to the train moving through it. These are all the causes which produce resistance in the train moved. But independently of these, there are resistances peculiar to the engine, arising from the friction or attrition of the various parts of the machinery which are in motion, and which suffer a pressure or strain, depending on the resistance of the load drawn; also, the re-action of the steam, escaping from the

blast pipe on the other side of the piston, and other similar causes. But to simplify the inquiry in the first instance, the resistance of the engine was put aside, and the investigation was directed exclusively to the resistance of the train. Various methods presented themselves for testing this. The most direct method was the application of an instrument called a dynamometer in front of the train, by which the train could be drawn, and which would afford a direct measure of the force with which it was so drawn. This method, however, was subject to several objections. It was found that the surface of the rails, commonly regarded as level, were really subject to variations of inclination through small distances, which produced upon the dynamometer sudden jerks, which caused its index to play between such extreme limits as to render it impossible to arrive at any useful mean of its indications. Besides this, if such an instrument were used to estimate the resistance of a train, moving with any considerable speed, it must necessarily be placed between the engine and the train, and would therefore show only a modified effect of the atmospheric resistance; inasmuch as the engine would have already encountered and removed a portion of that resistance before the instrument could be effected by it. Numerous experiments were nevertheless made with such instruments, and it was not abandoned until its failure was rendered practically manifest. Another method occurred to Dr. Lardner for determining that portion of the resistance which is due to friction, by attaching to an engine such a load as the engine is capable of moving, at a slow uniform velocity, up a given inclined plane, and then taking the same load to a more steep inclined plane and detaching from it as many wagons as would enable it to move up the steeper inclined plane at the same slow speed as that at which it moved up the less steep inclined plane. Under these circumstances it might be safely assumed, that the absolute resistance to the engine would be in both cases the same, and the difference of the gravity of the two inclined planes would, in such a case, by the aid of mathematical principles, and by formulæ, which Dr. Lardner constructed, give the resistance due to the wagons detached in passing from the less to the more steep inclined plane. This method would be attended with the advantage of giving a result, in a great degree, free from the atmospheric resistance, and therefore would furnish a near approximation to the value of the friction, properly so called. As the motion would be slow, and a part of the train would be in front of the wagons detached, the atmospheric resistance would necessarily have but a very slight effect. As no opportunity, however, presented itself of executing experiments upon this principle, he did not occupy the time of the Section in enlarging upon it.

After much consideration, he arrived at the conclusion, that the method of investigation which was calculated to give the most satisfactory results as to the resistance of railway trains was, by observing their motion down steep inclined planes. This method had been already practised, and its principles will be easily rendered intelligible. If a body be placed on a steep inclined plane, and allowed to descend it by the force of its gravity, its motion down the inclined plane would be accelerated. If the causes of the resistance affecting the body were uniform in their effect, and independent of the velocity, then the motion of the body down the inclined plane would be uniformly accelerated, just as a body falling freely and perpendicularly by gravity would, apart from the atmospheric resistance. By being uniformly accelerated, is meant this, that the increase of velocity which takes place every second of time is the same. Thus, whatever velocity is

acquired by the body at the end of the 1st second, having descended from a state of rest, twice that velocity will be acquired at the end of the 2d second, and thrice that velocity at the end of the 3d second, and so on. It is evident, therefore, that a body, subject to such acceleration, would go on increasing its speed without any limitation. As the intensity of the force of gravity is exactly known, and as the effect produced in diminishing that intensity by a plane of given inclination is a matter of easy and exact calculation, nothing can be more certain than the computation of the motion which a body would have down an inclined plane if that body were subject to no resistance. Now, if it be subject to resistance, the comparison of its actual and observed motion, with the motion which it would have, being subject to no resistance, computed, as just explained, ought to supply means of determining the amount of the resistance; but to do so it is necessary to know, to a certain extent, the law of the resistance which is in operation.

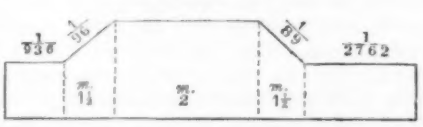
The resistance arising from attrition or friction, whether it be of surfaces rubbing one on another in the manner of a sledge, or rolling one on another as the tire of a wheel rolls upon a rail, or subject to the kind of attrition which takes place between the axle of a wheel and its bearings, have been all submitted to most elaborate and careful experimental inquiry; and the laws of the resistances, arising from these, have been fully and clearly developed. The question of friction was formerly investigated by Coulomb, Ximenes, Vince, and others; but recently a more extensive and valuable series of experiments on the subject, than was ever before executed, has been made, under the order of the French government, by M. Morin, and their details made public. The results of these fully corroborate the laws which had already resulted from the inquiries of the philosophers who before examined the subject, which laws are as follows:—1st, the resistance arising from friction, whether of rubbing or rolling, or that between the axle of a wheel and its bearings, are, when other things are the same, independent of the velocity; 2d, other things being the same, these resistances are directly proportional to the amount of pressure on the rubbing surfaces, and independent of the magnitude of these surfaces. To these laws, taken within practical limits, there can scarcely be said to be an exception. The extreme cases which become exceptional, having no application whatever to the present inquiry, it will not be necessary to regard them.

The immediate consequence, from the friction being the same at all velocities, is, that it is a uniformly retarding force, that is to say, that it destroys in the moving body on which it acts equal velocities in equal times. Thus, if it destroy a certain amount of speed at the end of one second, it will destroy twice that at the end of two seconds, three times at the end of three seconds, and so on. Now if a railway train, moving down a steep inclined plane, were subject to no other resistances than those arising from friction, it is evident that it would move down the plane with a uniformly accelerated motion, although that motion would be less accelerated than if it were subject to no resistance. In other words, the *kind* of motion affecting it would be the same as if there was no resistance, the *degree* of motion alone being altered. It has been stated that, subject to no resistance, certain speeds would be gained by the train in one, two, three, seconds. These speeds would be those due to the gravity of the plane. These speeds would, however, now be diminished by the amount of velocity destroyed by the friction; and as this latter would be increased in the same proportion as the speed imparted by gravity, the descending body would be accelerated by a uniform force, equal to the difference between the acceleration of gravity

and the retardation of friction. In a word, both of these being uniform and independent of the velocity, their difference, that is, the effective accelerating force, down the plane will be uniform and independent of the velocity.

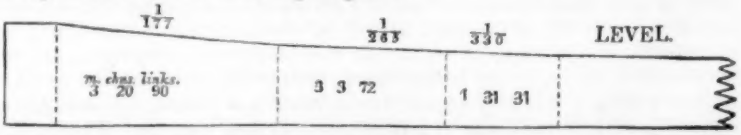
Such was the reasoning on which was based all former investigations of the resistance of railway trains, by observing their motions down inclined planes. The acceleration due to gravity was calculated; the actual acceleration moving down the plane was observed, and the difference was supposed to give the retarding force due to the resistance. It is evident that by such a mode of proceeding, the effect of the atmosphere, or of any other cause which produced a retardation increasing with the speed, was either neglected, or was considered to be of such trifling amount, compared with the resistance due to friction, that it might be regarded as involved in the estimate of resistance thus obtained with sufficient accuracy for practical purposes. Such, indeed, was the impression on Dr. Lardner's own mind when he commenced this investigation, and he accordingly proceeded on the same principles as those adopted by other inquirers, except that in the formulæ he included the effect of the gyration of the wheels, which was neglected in the calculations of M. de Pambour, and which omission entailed an error upon his results.

With a view to determine the actual acceleration of a train down an inclined plane, the Whiston and Sutton inclined planes on the Liverpool and Manchester Railway, and a series of inclines on the Grand Junction Railway, extending from Madeley for several miles towards Crewe, were selected. This figure represents the inclined planes on the Liverpool and Manchester Rail.



way. The summit level which lies between them is about two miles in length; the Whiston inclined plane descends towards Liverpool, falling at the rate of 1 in 96 for about a mile and a half, and is succeeded by an inclination which rises at the rate of 1 in 936 for a considerable distance. The Whiston and Sutton inclined plane falls, towards Manchester, at the rate of 1 in 89 for about a mile and a half, and is succeeded by a portion of the line nearly level, for a considerable distance towards Manchester.

The first plane on the Grand Junction line descended from the Madeley summit towards Crewe, falling at the rate of 1 in 177 for a distance of three miles and a quarter; this is succeeded by another which falls at the rate of 1 in 265 for a distance of rather more than three miles, which is succeeded by another falling 1 in 330 for a distance of nearly a mile and a half. This last is succeeded by a level, which continues for several miles. These planes are represented in the following diagram.



The Whiston and Sutton inclined planes on the Liverpool and Manchester line, are straight thoughout nearly their whole length. The Madeley inclines, represented in the diagram, are, in some places, curved with a ra-

dius of a mile, turning alternately to the right and to the left; but considerable portions of them are straight. A stake, marked 0, was placed at the summit of each inclined plane, and the length of the plane descending was divided out by stakes marked successively, 1, 2, 3, &c., into spaces of one hundred yards. Watches, by which a second could be without difficulty bisected, were provided, and the moment of passing the successive stakes was observed to be within, at the most, half a second of the truth. Every care was taken to confer the last degree of accuracy upon these observations; one person was employed to call out the moment of passing each stake; another, supplied with a watch, declared the time, and the third took it down; and in many cases these were checked by having two sets of observers.

A few experiments conducted in this manner soon made it manifest that the motion down an inclined plane was not, as has been hitherto supposed, uniformly accelerated. It was found, for example, that the increase of speed in each successive interval of time was not the same, but was continually less as the motion increased. In other words, the degree of acceleration *was gradually diminished.* Now this was an effect evidently indicating an increase of resistance with the increase of speed, and naturally suggested the idea that the atmosphere must have had a more considerable effect than had been supposed. The mathematical formulæ, commonly used for the determination of resistance, are founded, as has been already stated, on the supposition that the resistance is independent of the speed. These formulæ were now applied to the motion of the train down the inclined planes for short distances, measured from the points at which the trains were respectively started, so that within the range of their application the train might acquire but very little speed, and therefore that the result might be only slightly affected by the atmosphere. The results of such calculations, applied to the motion of the train for 100, 200, or 300 yards, were found to give a resistance, amounting to from the 400th to the 450th of the load. This was not half the amount of the common estimate of the resistance to railway trains, which was about the 250th part of the load, that resistance having been assumed to be the same at all speeds. It occurred to Dr. Lardner now to attempt an approximation at the resistance by another process, as follows:—trains were brought to a level and straight line of railway, and, being driven by an engine until they attained a speed of 30 to 35 miles an hour, they were dismissed, and allowed to run until, being gradually retarded, they were brought to rest. The line being staked out as before the moments of passing, the successive stakes were observed, and the rate at which the train was retarded by the resisting forces was observed, for each 100 yards over which it moved; a calculation was made of the amount of resistance by the usual formulæ, founded on the supposition that the resistance is independent of the speed; but these calculations being confined to the first 100, 200, or 300 yards, might be considered as giving a fair approximation, since the change of velocity throughout that distance was not very considerable. The result of such observations indicated a resistance amounting to from a nintieth to a hundredth of the load. It will be observed that in these last cases the velocity of the train, at which the resistance was computed, was very considerable, while, in the former cases, taking the initial motion down an inclined plane, it was very small. The inference, of course, which followed, supposing such calculations to give correct results, was, that the actual resistance at high speeds was many times more than when the motion is slow. Since, however, these methods of calculation could be regarded as only ap-

proximative, and were, in fact, based on principles which were only true on the supposition that the resistance was independent of the velocity, which supposition was contradicted by the results of the calculations themselves, it was considered necessary to resort to some other and more correct method of determining the resistance.

If it be admitted that the atmosphere produces any considerable resistance, since that resistance must increase in a very high ratio with the speed, it would follow, that if an inclined plane of sufficient length could be obtained, the motion of a train would continue to be accelerated until it would obtain a velocity which would produce *a resistance from the air, such as, combined with friction, would be equal to the gravitation down the plane.* When such a velocity should be attained, the moving force down the plane, being equal to the resisting force, no further acceleration would take place. As it was thought, however, that the inclined planes, which were accessible, might be not of sufficient length to produce this effect with such trains as it was possible at that time to obtain for experiments, it occurred to Dr. Lardner that the end would be equally attained by starting the train from the top of the inclined plane at a considerable speed; that thus, the acceleration it would receive while descending being added to its initial speed, might be expected to give that velocity, at some point of the descent which would be attended by a resistance equal to the gravitation of the train down the plane; at which point, therefore, acceleration might be expected to cease, and a uniform motion to be maintained to the bottom of the plane.

The first experiments tried with this view were completely successful, and the result obtained was in exact accordance with what had been anticipated. On the summit level of the Liverpool and Manchester Railway, marked in the diagram, No. 1, a train of four carriages was placed, and was drawn by an engine to the top of the Whiston plane ($\frac{1}{96}$) from whence it was started at a considerable speed. Its motion was accelerated for a short distance, but soon became perfectly uniform; and it descended through the greater part of the plane at the uniform velocity of 31.2 miles an hour. This experiment was again repeated with the same coaches, increasing the load. As was expected from the gravitation of the increased load, a greater velocity was now obtained; but still a uniform velocity resulted, and the train descended the plane with the most perfectly uniform motion, at 33.72 miles an hour. These experiments were tried repeatedly on the same day with the same results. A moderate wind blew down the plane, so that the inference was, that this train, in a calm atmosphere, would have suffered a resistance greater than a ninety-sixth part of its weight, at the velocities above mentioned. This experiment, with a train of four coaches, was repeated on the Sutton plane, and on the inclines near Madeley, represented in the diagram; and in every case a uniform velocity was obtained—this velocity diminishing with the steepness of the plane.

When these first experiments became known, one of the objections brought against them was, that a train of four coaches was so light, that a moderate atmospheric resistance would retard it: and that as, in the practical working of railways, such trains were never used, the results obtained had no practical utility; and that with heavy trains, such as those actually used on railways, no such results would ensue. This objection, among others, was advanced in a Report published by Mr. Brunel, the engineer, of the Great Western Railway. In order to meet this objection, trains of greater magnitude were subsequently tried, and the same results ensued—a uniform velocity being attained in every case in which the train could be

started from the top of the plane with a sufficiently high speed. In the following table is exhibited the mean results of a vast number of experiments tried with trains of four, six, and eight coaches. In the third column, the letter expresses generally the state of the wind—F fair, A adverse, C moderately calm, and CC a dead calm; the fourth column gives the gradient down which the motion took place; and in the last column is expressed, in miles per hour, the uniform velocities which the train attained, and which it preserved through a length of the plane sufficiently considerable to show that it would not have received any further increase.

Numb erof Coaches.	Weight.	Wind.	Gradient.	Uniform velocity attained.
	Tons.		One in	Miles per h.
4	15.6	F	96	31.2
4	18.	F	96	33.72
4	18.	F	177	21.25
4	20.5	F	177	22.9
4	20.5	F	89	38.25
4	20.2	F	265	19.13
6	27.5	A	89	32.3
6	27.5	F	89	37.5
6	27.5	F	96	34.6
6	27.5	A	96	27.8
6	34.5	C	89	35.3
8	36.5	F	89	>36.5
8	40.75	F	177	26.15
8	40.75	S	177	<17.7
8	40.75	CC	89	31.4

The last experiment with a train of eight coaches, weighing nearly forty tons, shows that in a dead calm, the resistance of *that train at* $31\frac{1}{2}$ *miles an hour amounted to the eighty ninth part of its weight; whereas the common estimate of the resistance of such a train at that speed has been hitherto about the* 250*th part of its weight!* This fact alone, were it unconnected with any others, would sufficiently illustrate the enormous extent of error which has prevailed hitherto in such estimations in railway practice. The third experiment with eight carriages was made with a side wind, the effect of which is abundantly manifested by the speed expressed in the last column. While the same train, moving with a fair wind down the Madeley plane, had a resistance equal to the 177th of its weight, at 26 miles an hour, its resistance with a side wind was of greater amount at 17.7 miles an hour.

The relative effects of a fair and adverse wind, are likewise exhibited in the third and fourth experiments with six coaches, down the Whiston plane. The velocity which gives a resistance equal to the 96th part of the load, was $34\frac{1}{2}$ miles an hour with a fair wind, and only $27\frac{3}{4}$ with an adverse wind.

When the first experiments indicating these results became public, various objections were urged against them by Mr. Brunel; and although it was not considered by Dr. Lardner, or by any of the other persons engaged in this inquiry, that such objections were entitled to any serious attention, yet it was thought advisable to make experiments which would show whether or not they had any foundation in truth. One of these objections was the following: that the cirumstances under which such experiments were performed,

were not really, though they were apparently, similar to those of an ordinary train in motion; that the carriages were here sent with the square end foremost, to meet and receive the full resistance due to their surface, which is totally different from the case in which the engine precedes them.* The engine in front, it was stated, would act as a sort of cut-air, or bow, and thus destroy or diminish the resistance produced by the flat front of the carriages moving foremost. In order to ascertain the full value of this objection, Dr. Lardner took an engine, 'The Fury,' with her tender, and obtained two coaches, weighed so as to be nearly equal in weight to the engine and tender. The connecting rods and working-gear of the engine were detached from the driving wheels, so that the engine should be subject to no other friction save that which a coach is subject to. The Fury and its tender, and these two coaches, thus prepared, were placed successively at the summit of the Sutton plane, falling $\frac{1}{89}$ towards Manchester, on the Liverpool and Manchester Railway; and they were allowed to descend by gravity. The circumstances of their descent were found to be, in all respects, alike, passing corresponding stakes at very nearly the same time, and very nearly the same speed. The full particulars of this, and other experiments, will be published; but, in the meanwhile, the principal results of this experiment are exhibited in the following table:—

	Weight.	Total distance run.	Time of running total distance.	Greatest speed.	Total of descending the Sutton plane. 1.89
	Tons.	Yards.	m. s	m. p. h.	m s.
Fury and Tender	11.39	4.710	11 57	29	4 29
Two coaches	11.33	4.577	11 40	28.12	4 24
Difference	.06	.133	0 3		0 5

It appears, therefore, that the difference in the whole distance run by the coaches, and by the engine and tender, amounted to only 133 yards, in a distance little short of three miles; and that there was only three seconds difference in the time. The maximum speed attained was nearly the same; and the time of descending the inclined plane only differed by five seconds. This difference, such as it was, was in favor of the coaches with their flat front. In fact, the differences of the numbers in the successive columns of the above table, are only such as would take place in the same experiment tried twice successively with the same coaches.

TO BE CONTINUED.

Sulphur Monopoly.

In consequence of the monopoly of sulphur in the Island of Sicily, granted to the king of Naples, the English have turned their attention to the extraction of this material from its native compound which exists abundantly in every country in which metallic ores abound. It may be that a resource

* Mr. Brunel's Report to the Directors of the Great Western Railway Company, 27th Dec. 1838, p. 9.

of this kind will be found advantageous in the United States, where the sulphurets of iron, lead, and probably of other metals, exist in profusion.

The effect which this monopoly has had, (says the Mining Journal,) will, in the end, we are satisfied, be highly productive to the mines of this country; attention having been directed to the sulphur ores, which are found so abundant in our mining districts, in combination with other metallic substances. We had occasion to note that mundic was now being shipped to the chemical works in the north, and a remunerative price given per ton, and, to our knowledge, we may add, that contracts to the extent of some thousands of tons have been entered into of late, for the supply of sulphur ores from Cornwall and Ireland. The circumstance of this hitherto valueless substance being now found to be applicable to the manufacture of sulphur, induces us to hope, as we verily believe, that, ere long, we may be independent of Sicily and other parts from whence this article is imported into this country. Min. Jour.

Novel Wind Engine.

We have been much gratified this week in examining a wind engine for fen drainage upon a very improved construction. The object of the inventor (Thomas Brighty, Esq., of Ramsey) seems to have been to produce a machine that shall not be affected by the head thrown against it, to render the least motion of the air available to raise a corresponding weight of water, which may be increased exactly in proportion to the strength of the wind, and (what is entirely a new feature in the above machine) it may be safely left "to take care of itself," requiring only occasional attendance; it clothes itself when the water is high, and when low, unclothes and stops; and let the wind be ever so strong, it cannot stir until the water has again risen to a certain pitch; then, if the wind is sufficiently strong, it clothes and sets itself in motion, and continues going until the water is reduced to a certain level, when it at once unclothes and stops. The machinery is extremely simple, and not subject soon to get out of repair.—*Cambridge Independent.*—[We believe there is nothing novel in the application of the windmill, or wind engine, whether as regards Cornwall or North Wales, having seen them applied to the purposes of drainage in both. In the neighbourhood of Holywell is one erected, if we mistake not, by Messrs Rigby, at a lead mine, which is most perfect and simple in its construction, requiring little or no attention; it turns with the wind, shuts up shop, and does all that is necessary to render it serviceable; it is of great power, and used for working crushers or grinders. Mr. Concanen also gave a description with an illustration, in the *Mining Journal*, some time since, of an improved wind machine.—Ed. M. J.]
Ibid.

Extraordinary Blast.

The workmen at present employed by his Grace the Duke of Buccleugh, at Boykine Craigs, in the parish of Westerkirk, near Langholm, on a trial for a slate quarry, have frequently been required to blow away part of the adjoining whinstone rock by means of gunpowder. A few days ago they had bored the rock to the depth of three feet, and charged with about 2 lbs. of powder, which, when it exploded, lifted out a block of stone measuring $3\frac{1}{2}$ feet square, and threw it to the distance of fifty-one yards at a single bound. What renders this the more astonishing is, that the block was closely wedged in on all sides but the front, and the bottom was broken completely out of

solid stone. By the usual mode of calculation it cannot weigh less than 3½ tons, and now lies on the spot where it was thrown out of the quarry for the inspection of the curious. Ibid.

Consumption of Coal and Iron at Bordeaux.

Bordeaux consumes annually 5,000,000 kilogrammes of iron—of which quantity 500,000 kilogrammes are imported from England, and 200.000 from Sweden. The rolled iron comes principally from England and Angouleme; the thin steel-iron is also supplied chiefly from England. There are about from 5000 to 6000 boxes of sheet tin used annually in Bordeaux; one house alone sells nearly 3000, and the whole of it is of English manufacture. There are two depots for sheet copper at Bordeaux, the consumption of which is very great for the sheathing of ships, and a great deal is also used by the manufacturing braziers. The quantity of coal consumed at Bordeaux, does not exceed 241,340 quintals—of which 200,000 are imported from England. This small comparative consumption of coal, arises from the proximity of the pine forests, which supply an excellent combustible at much less price than coals can be purchased. Ibid.

On Browne's Patent Hydraulic Level. By A. F. Hemming.

This instrument designed for ascertaining the relative heights of points not visible from each other, consists of lengths of water-tight flexible tubing, attached to each other by brass joints, and having glass vessels at each end. The vessels and tubing being nearly filled with water, the level of the water, as seen in these vessels at two points whose relative heights are to be compared, will serve to indicate their positions, whatever may be the inflexions of the tubing betwixt the two vessels. Graduated rods are placed perpendicularly at the points of observation, and the lower vessel is raised, and the higher lowered, until the level of the fluid therein intersects the graduation of the rods. It is conceived that this level may be peculiarly useful to mines and excavations, and in fixing complicated machinery. Transactions of Civil Engineers.

Railway Property as an Investment.

A correspondent calls our attention to the extraordinary increase in the value of railway property, which has taken place within the last six months. Comparing the quotations in our share list of the 14th December last, with those of the 13th inst., it will be seen that upon twenty lines this increase amounts to upwards of *eight millions sterling!* Thus the Great Western shares in that period have risen 52*l.* per share, namely, from 10 discount to 42 premium, equal to 1,300,000*l.* upon the 25,000 original shares; the new shares have risen from 5 discount to 20 premium, equal to 625,000*l.*—making altogether 1,950,000*l.* upon the old and new shares. The London and Birmingham shares have in like manner risen from 50 premium to 99 premium, equal to 1,225,000*l.* upon the 25,000 original shares; the quarter shares have risen from 22 to 30 premium, equal to 200,000*l.*; and the new shares have risen 13*l.*, equal to 405,950*l.*—making altogether upon the shares a sum of 1,830,950*l.* The shares of the other lines in the following table are computed in the same manner:—

Great Western, . . .	£1,925,000	Brought forward, .	£7,321,950
London and Birmingham, . .	1,830,950	Great North of England, . .	150,000
Grand Junction, ...	829,000	London and Blackwall, . .	120,000
London and South-Western, .	612,000	York and North Midland, . .	120,000
Eastern Counties, ...	488,000	Birmingham and Gloucester, .	95,000
North Midland, ...	420,000	Chester and Crewe, ...	90,000
London and Brighton, . . .	360,000	Bristol and Exeter, ...	90,000
Manchester and Leeds, . . .	312,000	Cheltenham and Great Western,	75,000
Midland Counties, ...	240,000	Birmingham and Derby, . .	63,000
Manchester and Birmingham, .	180,000	London and Greenwich, . .	60,000
London and Croydon, . . .	165,000		
Carried forward, . . .	£7,321,950	Total improvement in value,	£8,166,950

These results cannot fail, as our correspondent remarks, to be most gratifying to railway proprietors, as showing that public opinion has undergone a change; that railways are no longer viewed with suspicion as the mere speculations of a day, to be spoken of in the same breath with Spanish bonds and American state paper, but that they are regarded as real and valuable investments in the soil. Railway Times.

Mechanics' Register.

Unwoven Cloth and Glass Tapestry.

This French device must have very remarkable results. Two specimens of it were exhibited at the Marquis of Northampton's last *soiree*, as President of the Royal Society, and they then excited the curiosity and astonishment of the assembled *elite* of our philosophers. They were rich silk curtains, having all the appearance of being inwoven in gold and silver in most gorgeous patterns of arabesque. They looked and felt exactly like the most splendid hangings of the Louis Quartorze; but their cost is a mere trifle in comparison, for the *gold* and *silver* are merely *woven glass*. The Queen of the French and her daughters appeared at the last balls in the Tuilleries in dresses manufactured upon this principle. John Bull.

Locomotive Carriage.

Mr. Hill lately made a very successful trip to and from Camberwell and Brighton with his patent locomotive carriage; the distance from Camberwell to Brighton was performed in 5 hours and 10 minutes, out of which time 1 hour 21 minutes was lost by delays in obtaining a supply of water at the inns, and 10 minutes delay on the road. The return trip was accomplished in 5 hours 22 minutes, out of which time 1 hour 4 minutes was lost by delays in obtaining water, and 26 minutes delay by stoppages on the road; the delays in obtaining water will be reduced very considerably, when proper stations and stated periods for arrival are made, the whole of the stoppages need not occupy more than 12 minutes, which, according to the speed the carriage ran on the road, the journey from London to Brighton might be very well accomplished in about three hours and a half. Our correspondent, who accompanied Mr. Hill on his trip to London, states that the form of the carriage is a handsome britzka, that there is scarcely any noise from the working of the engine, or escape of steam, and no appearance of smoke; on descending hills

it is easily regulated by powerful retarders, and guided with the greatest facility. We hope at some future time to be able to give some additional information connected with the cost of a carriage, and the working of the same.

Arch. Jour.

Dredging the Thames.

It is a remarkable fact, that notwithstanding the enormous sum of £125,000 was expended in dredging the river Thames, off Woolwich, between the years 1808 to 1816, the river is now in as bad a state as ever, and the mud and silt are accumulating instead of decreasing. In 1816 alone, as much as £29,000 was thus expended, and the sum amounts on an average to £16,000 per annum to such little purpose.

Naut. Mag.

New Steam Vessel.

Experiments are in the course of being tried with the model of an entirely new form of steam vessel, and, as far as they have yet gone, with every prospect of a successful result. At present we can only state of this remarkable invention, that there are no paddle wheels, nor external works of any kind. The whole machinery is in the hold of the vessel, where a horizontal wheel is moved by the power of steam, and acting upon a current of water, admitted by the bow, and thrown off at the stern, propels the mass at a rapid rate. By a very simple contrivance of stopcocks, &c., on the apparatus, the steamer can be turned on either course, retarded, stopped, or have her motion reversed. This will be literally a revolution in the art of steam navigation.

Literary Gazette.

Fourdrinier or the Continuous Paper-making Machine.

Dr. Ure, in his Dictionary of Arts and Manufactures, observes that, "nothing can place the advantage of the Fourdrinier machine in a stronger point of view than the fact of there being 280 of them now at work in the United Kingdom, making collectively 1600 miles of paper, of from 4 to 5 feet broad, every day; that they have lowered the price of paper 50 per cent., and that they have increased the revenue, directly and indirectly, by a sum of probably 400,000*l*. per annum.

Mech. Mag.

"*Mode of Dowelling Timber, or of combining it and other materials for general purposes.*" By M. J. Brunel, M. Inst. C. E.

The author proposes to unite timber by means of iron dowels and asphalte. Mastic had been used in the Tunnel works for the purpose of fitting small plates of cast-iron to the poling boards. These, though constantly immersed in water and mud, and subject to severe hammering, had stood perfectly well. Asphalte is now used in preference to mastic, as it sets immediately. The author conceives that stone may be united by a similar kind of dowelling; and that wood may be interposed between stone and iron, so as to be used to advantage with the stone blocks, for the chairs of railways. Also, that this method may be used with great advantage in ship-building, in mast-making, and wherever any species of dowelling is required.

Lond. Jour. Arts & Sc.

LUNAR OCCULTATIONS FOR PHILADELPHIA, DECEMBER, 1840.					Angles reckoned to the right, or westward, round the circle, assecn in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
1	10	2	Im. N. Aquarii,	6	94°	140°
1	10	57	Em.		330	20
14	13	52	Im. *q* Tauri,	5,6	121	77
14	14	21	Em.		169	126
14	14	54	Im. 76 Tauri,	6	96	57
14	15	48	Em.		187	137
27	7	39	Im. *d'* Capricorni,	6	102	148
27	8	36	Em		320	10

Meteorological Observations for July, 1840.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	65	74	29.80	29.82	W.	Brisk.		Clear—cloudy.
	2	60	72	.95	.77	W.	Calm.		Cloudy—do.
	3	62	66	30.00	30.00	N.E.	do.		Cloudy—do.
	4	57	80	.02	.04	W N W.	Brisk.		Partially cloudy—clear.
	5	60	81	.12	.12	E	Calm.		Lightly cloudy—clear.
☾	6	61	72	.12	.10	N.E	do.		Partially cloudy—rain.
	7	63	68	.00	30.01	N.E.	Moderate.	.39	Rain—cloudy.
	8	64	72	.00	29.95	S E.	do.		Cloudy—do.
	9	70	75	29.80	.80	W.	do.	.35	Cloudy—rain.
	10	65	83	.80	.75	W.	do.		Clear—do.
	11	65	85	.90	.91	W.	do.		Clear—do.
	12	66	87	.90	.90	S W.	Calm.		Lightly cloudy—do.
	13	67	75	.75	.94	S.W.S.E	do.	.34	Partially cloudy—showery.
☉	14	73	85	.60	.61	W.	do.		Flying clouds—do.
	15	69	89	.76	.83	W.	Moderate.		Clear—do.
	16	70	91	.87	.90	W.	Calm.		Clear—do.
	17	74	89	.90	.87	S W.	Moderate.		Fog—clear.
	18	76	82	.85	.85	S W N E	Calm.	.27	Cloudy—shower.
	19	72	88	.83	.91	W.	do.		Cloudy—clear.
	20	65	77	.87	.93	N.E.W	do.		Clear—do.
	21	62	82	.93	.96	W.	do.		Clear—do.
☽	22	63	86	30.00	30.02	S.W.	do.		Clear—do.
	23	64	72	29.98	29.85	S.	do.	.41	Cloudy—showery.
	24	70	80	.57	.59	W N W.	do.		Cloudy.—do.
	25	65	82	.81	.95	N.W.	do.		Partially cloudy—do.
	26	64	84	30.01	30.05	S.W.	do.		Clear—do
	27	64	86	.05	.05	S W	do.		Partially cloudy—clear.
	28	65	86	.03	29.95	S W.	do.		Clear—flying clouds.
⊗	29	75	85	29.77	.80	W.	do.		Cloudy—clear.
	30	66	85	.96	30.00	W.	do.		Hazy—clear.
	31	70	79	31.00	.00	W	do.		Fog—cloudy.
	Mean	70.06	80.42	29.90	29.90			1.76	

	Thermometer.		Barometer.
Maximum height during the month.	89.00	on 15th and 17th.	30.12 on the 5th.
Minimum " "	57.00	on 4th.	29.57 " 24th.
Mean	75.21		29.90

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

OCTOBER, 1840.

	County.	Town.	Observer.	Thermometer.											Barometer.	
											Register.					
				7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Lowest.	Mean.	Days omitted.	7, A. M.	2, P. M.
1	Philadelphia,	Philadelphia,	J. M. Hamilton,	54.71	58.98	52.19	70.50	36.00	55.29	4 1/2	30.00	48.04	5	30.12	30.09
2	Montgomery,														
3	Bucks,	Newtown,	L. H. Parsons,	48.15	52.73	49.32	72.75	30.00	52.39	3/4	26.00	42.63	.	30.04	30.02
4	Lehigh,														
5	Northampton,	Easton,	Charles Elliot,												
6	Monroe	Stroudsburg,	A. M. Stokes,												
7	Pike,	Milford,	Ralph Bull,												
8	Wayne,	Honesdale,	W. Richardson,												
9	Susquehanna,	Silver Lake,	E. Rose,	43.74	55.74	48.81	70.00	27.00	49.43	.	24.00	39.84	.	28.09	28.15
10	Luzerne,	Wilkesbarre,	W. F. Dennis,												
11	Schuylkill,	Port Carbon	P. C. Lyceum,	43.84	62.08	46.97	83.50	25.00	50.96	.	24.00	39.18	.	29.39	29.35
12	Berks,	Reading,	C. F. Egelmann,	48.45	57.48	50.29	74.00	27.00	52.07	.	...	...	.	29.89	29.87
13	Chester,	West Chester,	Wm. W. Jefferies,												
14	Delaware,	Haverford,	Haverford School,												
15	Lancaster,	Lancaster,	Conservatory of Arts,	49.35	62.53	52.50	81.00	29.00	54.79	3/4	27.00	45.92	.	29.53	29.49
16	York,														
17	Lebanon,														
18	Dauphin,	Harrisburg,	J. Heisely,	50.65	56.83	51.89	71.00	32.00	53.12	2	30.00	47.90	2	29.78	29.74
19	Northumberland,	Northumberland,	Andrew C. Huston,	46.52	56.87	50.06	73.00	27.00	51.15	.	21.00	39.71	.	29.49	29.47
20	Columbia,	Danville,	C. H. Frick.												
21	Bradford,														
22	Tioga,														
23	Lycoming,														
24	Union,														
25	Mifflin,														
26	Juniata,	Mifflintown,	J. A. Rinkead,	43.15	61.85	47.24	79.50	21.00	50.74	2 1/2	....	....	.	29.53	29.49
27	Perry,														
28	Cumberland,	Carlisle,	Prof. W. H. Allen,												
29	Adams,	Gettysburg,	Prof. M. Jacobs,	45.84	59.40	50.06	75.50	27.50	51.60	.	24.00	42.18	.	29.44	29.43
30	Franklin,														
31	Huntingdon,	Huntingdon,	Prof. Jacob Miller,	45.13	62.86	49.29	77.00	23.00	52.43	3/4	....	....	.	29.38	29.35
32	Centre,	Bellefonte,	John Harris,	41.98	59.46	46.66	71.50	18.00	49.37	10	....	....	.	29.32	29.38
33	Potter,														
34	M'Kean,	Smithport,	Richard Chadwick,	40.39	55.52	40.03	76.00	23.00	45.31	.	19.00	36.23	.	28.08	28.10
35	Clearfield,														
36	Cambria,	Ebensburgh,	Richard Lewis,	42.66	55.41	44.50	78.00	12.00	47.52	4	12.00	38.34	2	27.89	27.88
37	Bedford,	Bedford,	Samuel Brown,	46.04	61.12	50.59	81.50	24.00	52.58	.	....	....	.	29.26	29.24
38	Somerset,	Somerset,	George Mowry,	44.17	55.69	47.00	71.50	19.00	48.95	5	17.00	38.16	6	27.95	27.94
39	Indiana,	Indiana,	Richard White,	50.72	57.64	45.88	78.00	22.00	51.41	6 1/3	....	....	.	28.64	28.62
40	Jefferson,	Rose Cottage,	C. C. Gaskell,												
41	Warren,	Warren,	C. S. Brown,												
42	Venango,	Franklin,	Wm. Connely,	40.83	65.00	50.39	79.00	22.00	52.07	2	....	....	.	29.10	29.07
43	Armstrong,														
44	Westmoreland,														
45	Fayette,	Uniontown,	J. P. Weithers,	49.13	62.98	47.98	87.50	18.00	53.36	.	....	....	.	29.03	29.02
46	Green,														
47	Washington,	Cannonsburg,	Prof. A. H. Campbell,	32.81	47.03	35.90	64.00	14.00	38.58	.	14.00	28.70	.	29.06	29.02
48	Alleghany,	Pittsburgh,	J. P. Bakewell,	52.23	59.00	53.08	75.00	29.00	54.77	.	....	....	.	29.30	29.29
49	Beaver,	Beaver,	James Allison,	46.29	64.18	48.97	81.00	22.00	53.14	1	....	....	.	29.45	29.42
50	Butler,	Butler,	Jacob Mechling,	47.42	59.87	53.19	82.00	24.00	53.49	.	....	....	.	28.84	28.83
51	Mercer,	West Greenfield,	S. Campbell,												
52	Crawford,	Meadville,	J. Limber,	55.37	58.28	46.47	81.00	28.00	53.37	1 1/3	18.00	33.66	2	28.74	28.71
53	Erie,	Erie,	Park & Reid,												

ometer.						Barometer.							Weather.							
			Register.																	
	Mean.	Days omitted.	Lowest.	Mean.	Days omitted.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	
)	55.29	4⅓	30.00	48.04	5	30.12	30.09	30.12	30.41	29.60	30.11	5⅓	15	10⅓	5⅔	8	....	....	..	6.
)	52.39	⅔	26.00	42.63	.	30.04	30.02	30.02	30.31	29.57	30.02	⅔	15⅓	13	2⅔	15	....	....	..	6.
)	49.43	.	24.00	39.84	.	28.09	28.15	28.04	28.50	27.70	28.09	.	10	21	.	6	2	....	..	2.
)	50.96	.	24.00	39.18	.	29.39	29.35	29.40	29.61	28.93	29.38	.	15⅓	15⅔	.	11	2	....	..	5.
)	52.07	.	...	...	.	29.89	29.87	29.90	30.16	29.44	29.89	.	14⅔	16⅓	.	9	....	....	..	3.
)	54.79	⅔	27.00	45.92	.	29.53	29.49	29.52	29.78	29.01	29.51	⅔	16⅓	14	⅔	9	....	....	..	4.
)	53.12	2	30.00	47.90	2	29.78	29.74	29.76	30.03	29.32	29.76	2	.	.	.	9	1	....	..	4.
)	51.15	.	21.00	39.71	.	29.49	29.47	29.48	29.73	29.01	29.48	.	12⅔	18⅓	.	12	1	....	1	3.
)	50.74	2⅓	....	....	.	29.53	29.49	29.52	29.80	29.04	29.51	2	15	13⅔	2⅓	5	1	....	..	..
)	51.60	.	24.00	42.18	.	29.44	29.43	29.43	29.68	29.87	29.43	.	17	14	.	12	....	....	..	7.
)	52.43	⅔	....	....	.	29.38	29.35	29.36	29.59	28.92	29.36	⅔	18	12	.	8	1	....	..	3.
)	49.37	10	....	....	.	29.32	29.38	29.26	29.61	28.49	29.32	10	10⅔	9⅓	11	6	....	....	..	4.
)	45.31	.	19.00	36.23	.	28.08	28.10	28.09	28.25	27.80	28.09	.	11	20	.	10	3	....	..	3.
)	47.52	4	12.00	38.34	2	27.89	27.88	27.88	28.10	27.51	27.88	4	10⅓	15⅓	5⅓	10	1	....	..	3.
)	52.58	.	....	....	.	29.26	29.24	29.26	29.45	28.80	29.25	.	16	15	.	....	....	....	..	..
)	48.95	5	17.00	38.16	6	27.95	27.94	27.95	28.14	27.60	27.95	5	11⅓	14⅔	5	8	2	....	..	2.
)	51.41	6⅓	....	....	.	28.64	28.62	28.62	28.90	28.30	28.62	6⅓	12⅓	12⅓	6⅓	....	....	....	..	..
)	52.07	2	....	....	.	29.10	29.07	29.14	29.90	28.51	29.10	⅓	14⅔	16	⅓	9	1	....	..	3.
)	53.36	.	....	....	.	29.03	29.02	29.04	29.21	28.60	29.03	.	22⅔	8⅓	.	7	....	....	..	3.
)	38.58	.	14.00	28.70	.	29.06	29.02	29.08	29.35	28.54	29.05	.	10⅓	15⅔	5	6	1	...	..	2.
)	54.77	.	....	....	.	29.30	29.29	29.30	29.50	28.86	29.30	.	11⅔	18	⅓	10	....	....	..	3.
)	53.14	1	....	....	.	29.45	29.42	29.46	29.68	29.10	29.44	⅔	15	14⅔	1⅓	7	1	....	..	3.
)	53.49	.	....	....	.	28.84	28.83	28.83	29.00	28.50	28.83	.	.	.	.	10	...	....	..	3.
)	53.37	1⅓	18.00	33.66	2	28.74	28.71	28.73	28.96	28.40	28.73	1⅓	15⅓	14⅓	1⅓	14	1	....	..	6.

ther.				Winds.																		Hygrometer.					
Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
..	....	..	6.900	½	.	1⅔	.	⅓	½	2⅔	.	4½	⅔	5⅔	.	1⅔	½	5½	.	.	7½	....	.	... .	....	.	1291
..	....	..	6.202	.	½	4	⅔	1	1	2⅔	½	⅔	½	6⅔	.	½	1½	10	½	.	1½	....	.	.....	....	.	1278
2	....	..	2.980	1⅔	.	.	.	.	.	1⅔	1½	4½	.	5⅔	.	7	.	9½	.	.	.	....	.	.....	....	.	1330
2	....	..	5.683	½	⅓	1⅔	⅓	2½	.	3½	.	3½	.	2⅔	.	5	½	2⅔	⅔	8	.	....	.	.....	....	.	1280
..	....	..	3.676	.	.	2⅔	.	1½	.	2½	.	1½	⅔	2½	½	1⅔	.	18	.	½	.	....	.	.....	....	.	1256
..	....	..	4.595	3	½	½	.	2	1½	4⅔	⅔	2	2½	3	1⅔	1½	1½	4⅔	1½	.	⅔	52.38	2	.....	56.93	2	1262
1	....	..	4.227	½	.	.	.	.	.	8½	.	2	.	3⅔	.	3	.	12½	.	.	1½	....	.	.....	....	.	1251
1	....	1	3.960	4½	.	4	.	2½	.	3⅔	½	3½	.	½	.	5½	.	2½	½	.	2⅔	....	.	.....	56.29	.	1252
1	....	..	.....	⅓	.	1½	.	⅔	.	3½	.	.	.	1⅔	.	2½	.	5⅔	.	13⅔	2	....	.	.....	....	.	1255
..	....	..	7.118	2½	.	3	.	.	.	3⅔	1	3½	2	6½	½	1½	1	6⅔	.	.	.	....	.	.....	....	.	1282
1	....	..	3.395	.	.	.	.	12½	.	.	.	.	.	.	.	18	.	.	.	.	⅔	....	.	.....	....	.	1275
.	....	..	4.182	½	⅓	.	.	.	.	.	.	1⅔	⅓	1	½	5½	.	3½	.	2⅔	15⅔	....	.	.....	....	.	1260
3	....	..	3.578	.	.	.	.	2½	.	5½	.	.	.	2	½	14	.	3	.	.	4	....	.	.....	63.50	18	1300
1	....	..	3.636	.	.	.	.	.	.	3⅔	.	2⅔	.	3½	2	7⅔	.	6½	.	1⅓	4	....	.	.....	....	.	1261
.	....	..	.....	.	.	.	.	.	1	3	.	2	2⅔	6½	½	5	.	2⅔	8	.	.	....	.	.. .	....	.	1254
2	....	..	2.972	½	.	.	.	⅓	.	1⅔	.	⅔	.	4	4	3½	⅔	3	.	7½	5⅔	....	.	.....	....	.	1253
.	....	..	.....	.	.	.	.	⅓	.	1½	.	⅔	.	5	.	8⅔	.	2	.	6⅔	6½	....	.	...	....	.	1305
1	....	..	3.323	.	.	½	.	.	.	7½	.	.	.	7	.	.	.	16	.	.	⅓	....	.	.....	....	.	1257
.	....	..	3.100	1½	.	⅔	.	.	.	⅓	.	4	.	11	.	4	.	5⅔	.	4	.	....	.	.....	....	.	1272
1	...	..	2.970	3½	.	2½	.	3	.	1⅔	.	.	.	2½	.	12½	.	2⅔	.	1	2½	....	.	.....	....	.	1302
.	....	..	3.051	½	.	⅔	½	3	⅔	2½	.	½	⅔	2⅔	1	6⅔	½	1⅔	.	10	½	....	.	.....	....	.	1258
1	....	..	3.473	.	.	1½	.	½	.	3⅔	1	.	.	3⅔	.	1½	.	13	⅔	5½	⅔	....	.	.....	....	.	1377
.	....	..	3.877	½	.	3	.	5⅔	.	1	.	⅓	.	7	.	12⅔	.	1	.	.	.	....	.	.....	....	.	1259
1	....	..	6.153	2⅓	.	.	.	⅓	.	1⅓	½	5⅔	1½	4½	⅔	3	⅔	2	.	.	9	....	.	.....	....	.	1274